Welding Engineer

JANUARY, 1961
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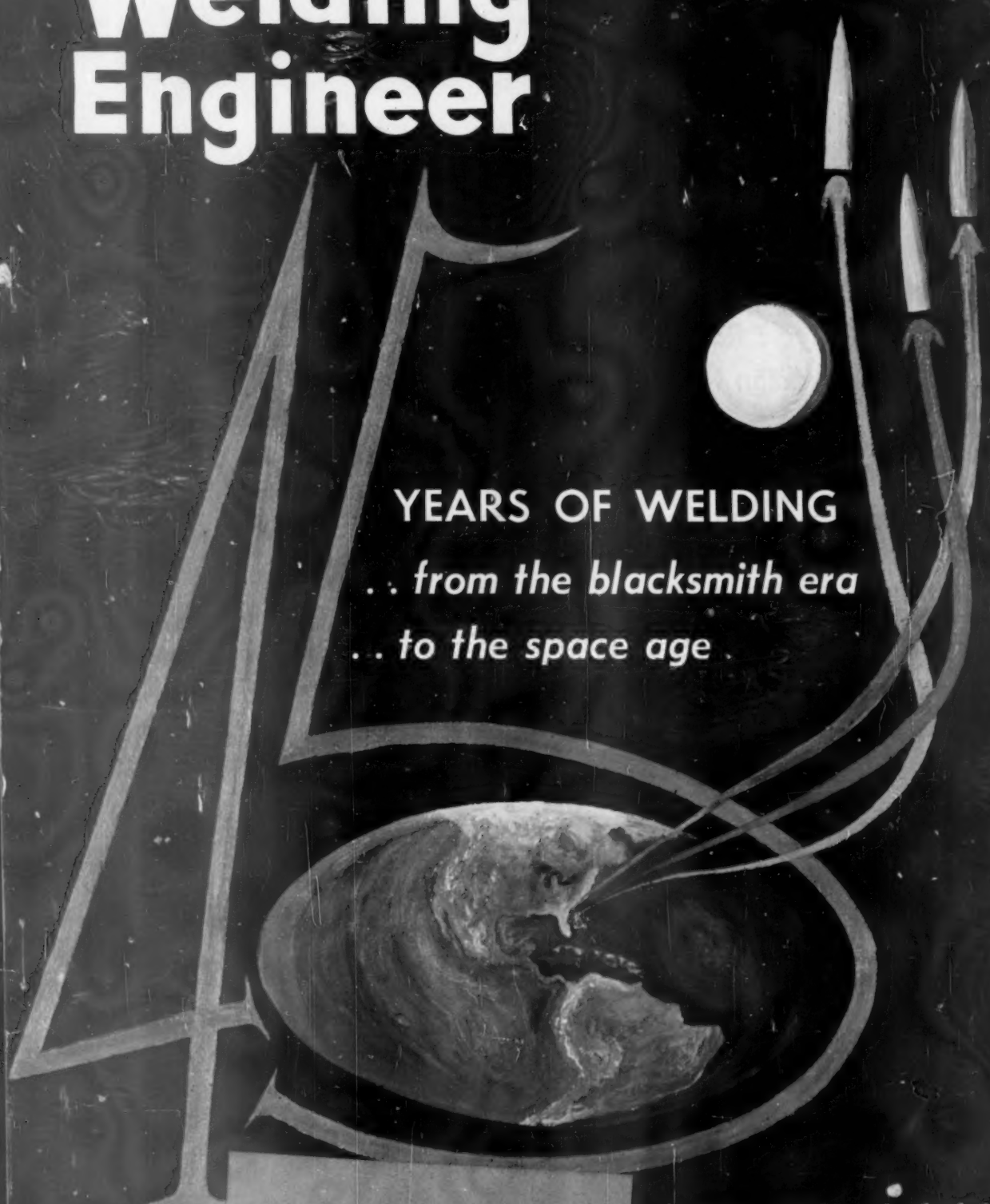

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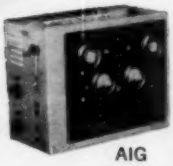

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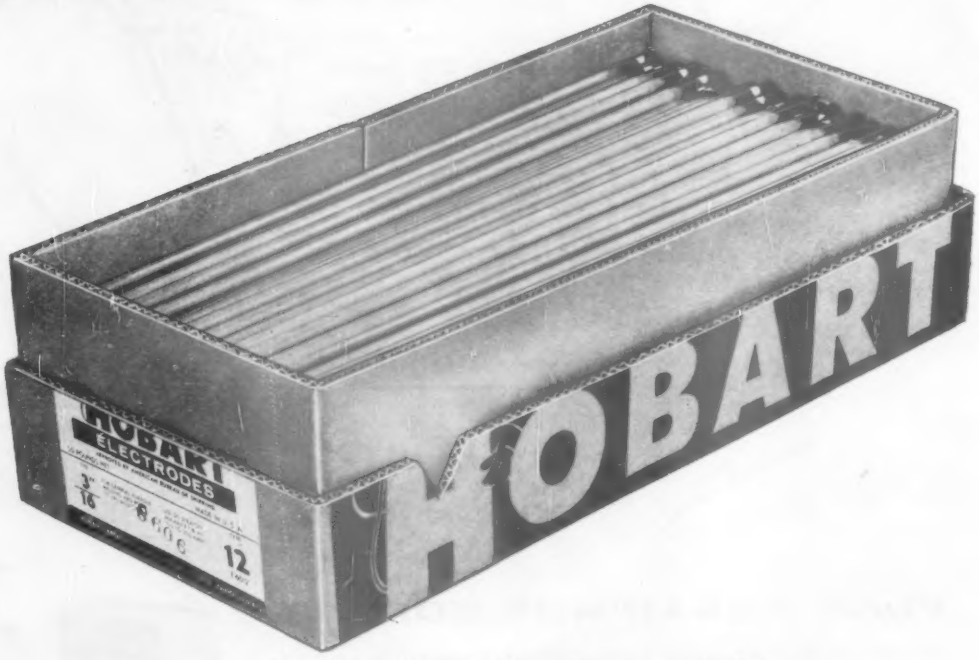

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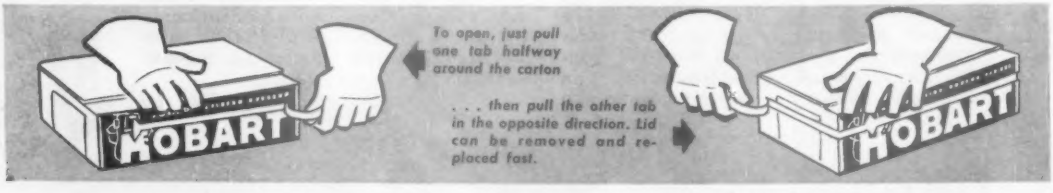
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. . . then pull the other tab in the opposite direction. Lid can be removed and replaced fast.
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VOL. 46—No. 1

Welding Engineer

The magazine of joining and severing of materials

This is welding: January, 1961

Cover photo . . . a reproduction of an original oil painting by Don T. Jefferson, WE's promotion manager.

45 years in

the welding world

Forty-five years of welding 31
From the blacksmith era to the space age, *WE* has reported welding's growth as an industrial tool. And its steady, at times explosive, growth can be seen in this brief history culled from our 63 years of publishing in the welding field.

How to select and use proper welding power sources 35
The first step in setting up a welding operation is selection of proper size and type power sources. Author **D. H. Hawes** details his firm's method of testing and evaluating each unit to be used, and discusses possible trends in power source manufacturing.
★ (For a reprint of this article, circle number 247.)

How temperatures are measured 40
Heat is not temperature, nor vice versa. Research Director **E. Kimmel** defines the two terms, then explains the principles behind the various temperature-measuring and indicating devices.
★ (For a reprint of this article, circle number 248.)

How to get the most from your resistance welder 42
Hundreds of hours and thousands of dollars are lost yearly due to welder malfunction or breakdown. But who's to blame when a resistance welder won't weld? It could be you, says Chief Welding Engineer **Harold Bach.**
★ (For a reprint of this article, circle number 249.)

Why you should braze small diameter piping 44
Silver brazing offers advantages in both service and installation, and hence, brazed joints are rapidly replacing threaded joints in commercial plumbing, according to author **Alden W. Swift.**
★ (For a reprint of this article, circle number 250.)

Welding leaders look to the future 52
What does the future hold for the welding industry? *WE* asked those men who know and work with welding for their opinions. And although they don't all agree on every point, some of their replies might surprise you, as well as indicate welding's newest industrial role.

Also in this issue:

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WELDING ENGINEER is indexed regularly by Engineering Index, Inc.

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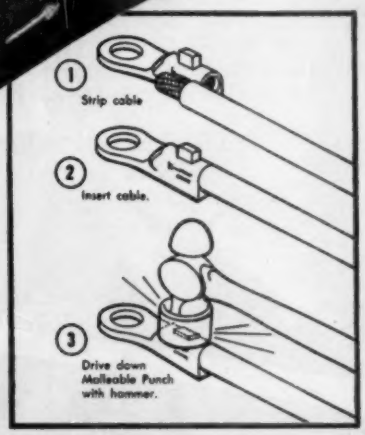

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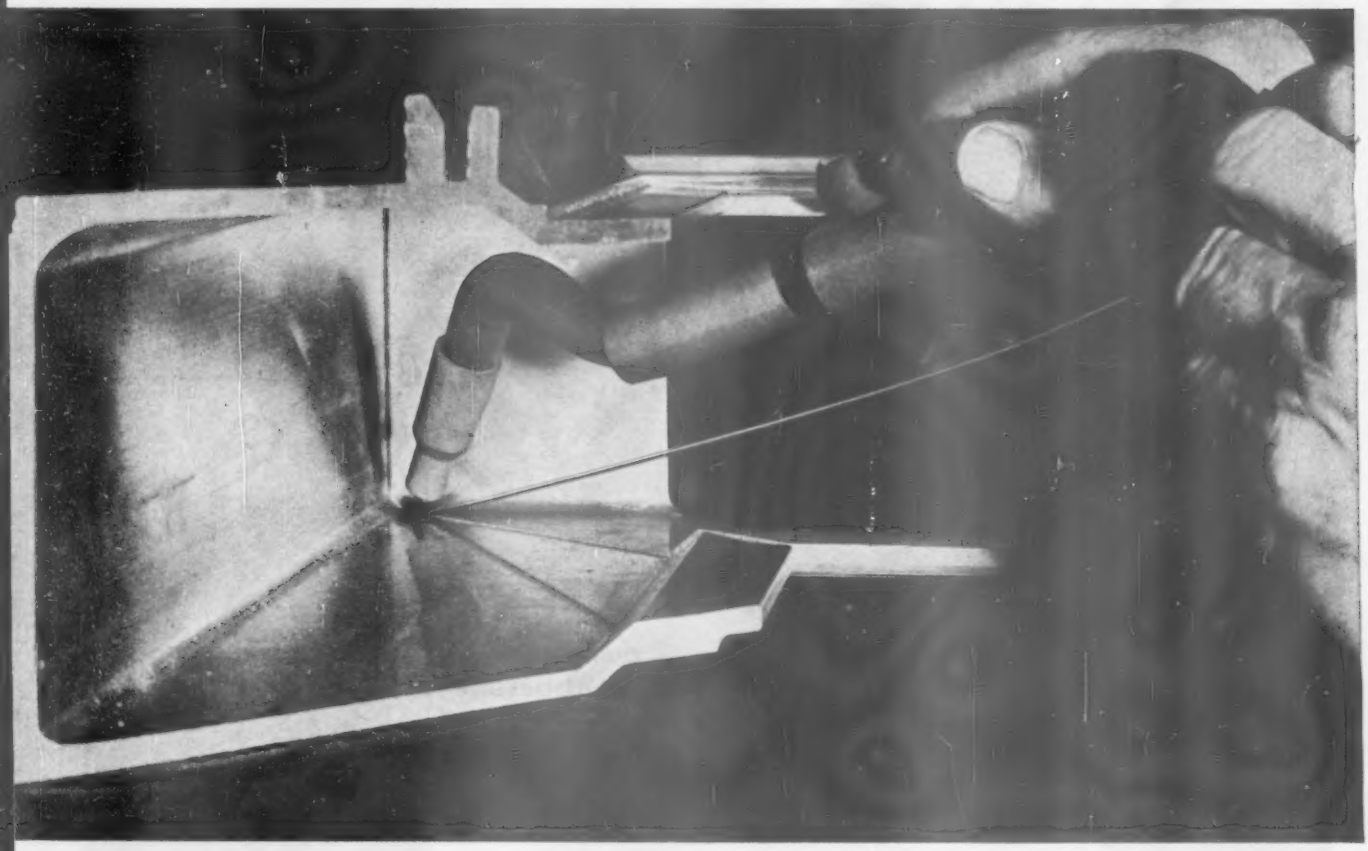

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A COPY of *Welding Engineer* is placed in the stainless-steel cornerstone of Eutectic Welding Alloy Corp.'s new addition by Herman C. Phelps, of Welding Engineer Publications, Inc. Eutectic president, Rene D. Wasserman (left), later welded the stone in place and announced plans for building a new metallurgical plant and research center.

Eutectic plans to construct $2 1/2 million metallurgical plant

Eutectic Welding Alloys Corp., Flushing, N. Y., will begin construction next year of a new $2½ million metallurgical plant and research center.

The announcement was made shortly after the cornerstone of the firm's new $500,000 addition was welded into place to celebrate Eutectic's 20th anniversary.

The new center, along with a pilot center already in operation in Switzerland, will make Eutectic the only firm in its field capable of producing rods and electrodes from virgin metal to finished product entirely in its own facilities, according to Rene D. Wasserman, president.

The center will include a foundry capable of melting and pouring any ferrous or non-ferrous alloy the firm needs. In addition, the center will be used for both production of highly-specialized alloys and for the development of new alloy systems, metallurgical processing procedures and materials standards and specifications.

The metallurgical center operating near Lausanne, Switzerland, will serve as a model and guide in the final planning for the new center.

Arcrods expands Cleveland plant

Work has begun on a 50,400-sq-ft. addition to the Cleveland facility of Arcrods Co., Sparrows Point, Md.

The addition will cost about $800,000 and will be used for wire drawing operations.

Plant show features 10,000 products

More than 10,000 cost-saving products will be featured at the 1961 Plant Maintenance & Engineering Show at Chicago's International Amphitheatre Jan. 23-26.

The exhibit area will cover six acres and more than 375 companies will participate. Nearly 4,000 experts will be on hand to answer the questions of an expected 20,000 visitors.

January's Headlines

Five workshop courses offered by Hobart

The non-profit Hobart Technical School, Troy, Ohio, has scheduled five intensive courses to be held during the first part of 1961.

The five-day courses, for which text and complete reference material will be furnished, are designed to upgrade the ability of key personnel to direct, control and evaluate fusion welding operations.

The first course, on induction heating for the welding industry, will be given from Jan. 9-13. The second, on welding fundamentals for supervisors and engineers, will be given on Jan. 16-20 and May 8-12. Other courses include: arc welding inspection and quality control on Jan. 23-27 and May 15-19; and the gas shielded arc welding processes on April 24-28.

Conference to highlight electroslag welding

An evaluation of electroslag welding will be one of the highlights of the seventh annual Midwest Welding Conference on February 1 and 2.

The conference, which is expected to attract nearly 300 welding engineers from industry, will be held on the campus of Illinois Institute of Technology, Chicago.

Major topics to be discussed at the meeting include: aluminum freight car welding, control of fabricating costs, and welding of ultra-high-strength steel missile cases.

WELDING PROBLEM is discussed by Ohio State University student, James W. Bradley (right), who was awarded National Cylinder Gas .Div.'s first welding engineer scholarship, and Prof. Roy B. McCauley, chairman of the university's welding engineering department.

RIGGER at Christy Park Works of U.S. Steel Corp's National Tube Division guides an assembly of welded-steel high-pressure storage tanks into position. Tanks were shipped to a Titan missile base in the United States under construction by Army engineers for the Air Force. The tanks contain high pressure helium and nitrogen which force liquid fuel and oxygen into the missile and purge the fuel systems after a firing.

CGA to hold 48th annual meeting

The Compressed Gas Association will hold its 48th annual meeting at the Waldorf-Astoria in New York City on Jan. 23, 24 and 25.

The annual members meeting will be on Jan. 25 to be followed immediately by an organization meeting of newly-elected board members.

Linde to build liquid hydrogen plant

Linde Co., New York City, will build a 26-ton-per-day capacity liquid hydrogen plant at Fontana, Calif.

The new plant will supply 21 tons per day of liquid hydrogen to the National Aeronautics and Space Administration under a $31,000,000 contract which Linde has just received.

Armco to modernize its pipe facilities

Armco Steel Corp., Middletown, Ohio, will spend $2½ million to consolidate its spiral welded pipe manufacturing operations in a modern fully-integrated plant.

Four new buildings with 207,000 sq ft of floor space will be erected to accommodate the pipe manufacturing facilities now located at the firm's main fabricating plant. Two new Driam pipe machines will also be installed in the new layout.

COMING EVENTS

JAN. 23-25, 1961: 12th Annual Plant Maintenance & Engineering Show, Palmer House and International Amphitheatre, Chicago.

FEB. 1-2, 1961: 7th Annual Midwest Welding Conference, Armour Research Foundation and Chicago Section AWS, Illinois Institute of Technology, Chicago.

FEB. 14-16: 2nd Annual Symposium on Nondestructive Testing of Aircraft and Missile Components, Gunter Hotel, San Antonio, Tex.

MAR. 20-24, 1961: 12th Western Metal Congress, American Society of Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

MAR. 24-25, 1961: Welding Show & Exhibit, Wichita Section AWS, Kansas National Guard Armory, Wichita, Kans.

APRIL 10-15: International Institute of Welding meeting, Sheraton-Atlantic Hotel, New York City.

APRIL 17-21: 42nd Annual Convention, AWS, Commodore Hotel, New York City.

APRIL 18-20: AWS Annual Welding Exposition, Coliseum, New York City.

APRIL 24-25: IAA Annual Meeting, Boston.

APRIL 20-MAY 4: Engineering Marine & Nuclear Energy Exhibition, Olympia, London.

Safety course offered to industrial foremen

A low-cost training course for industrial foremen is being offered by the National Safety Council.

The course consists of six booklets and a manual for discussion group leaders. Each booklet is a one-hour training session for foremen.

Curtiss-Wright offers two training courses

A course in industrial isotope radiography and another in ultrasonic testing techniques are being offered this month by the Nondestructive Testing Dept., Curtiss-Wright Princeton Div., Princeton, N. J.

Both courses will be given at their nondestructive testing laboratories. The inspection course will be from Jan. 23 to Jan. 27. The radiography course will be from Jan. 30 to Feb. 3.

McKay receives citation from chamber of commerce

A citation for its expanding role in developing the York, Pa., economy was awarded recently to The McKay Co., Pittsburgh, by the York Chamber of Commerce.

Frank Zehnder, manager of the firm's York plant, received the award at a recognition dinner in Pittsburgh.

AWS Wichita section to hold welding show

The Wichita section of AWS will present a Welding Show and Exhibit on March 24 and 25, 1961.

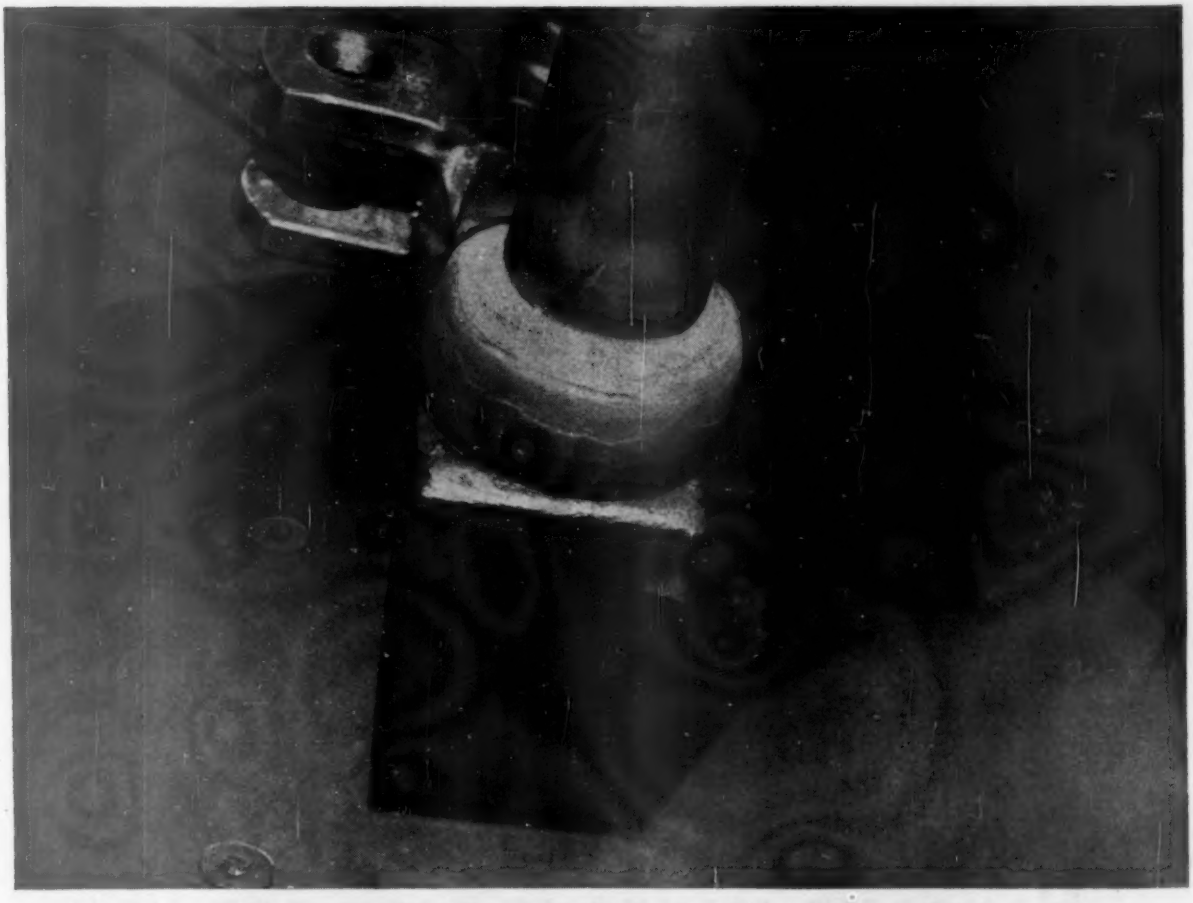
The purpose of the show is to bring the latest in welding equipment, processes and allied metals, materials and services to welding users in Kansas. Featuring live displays and demonstrations, the show will be held in the Kansas National Guard Armory which has a 17,000 sq ft display area.

Temperature symposium set for March

Almost every area of the physical, biological and medical sciences will be represented at the 1961 symposium on "Temperature, its measurement and control in science and industry," to be held in Columbus, Ohio, March 27-31.

The conference is being sponsored by the American Institute of Physics, Instrument Society of America and the National Bureau of Standards.

Research papers from all over the world will be presented covering temperature measurement from absolute zero to 10,000,000 K. Further information is available from: V. W. Sikora, Instrument Society of America, 313 Sixth Ave., Pittsburgh 22. (For more on temperature, see page 40).



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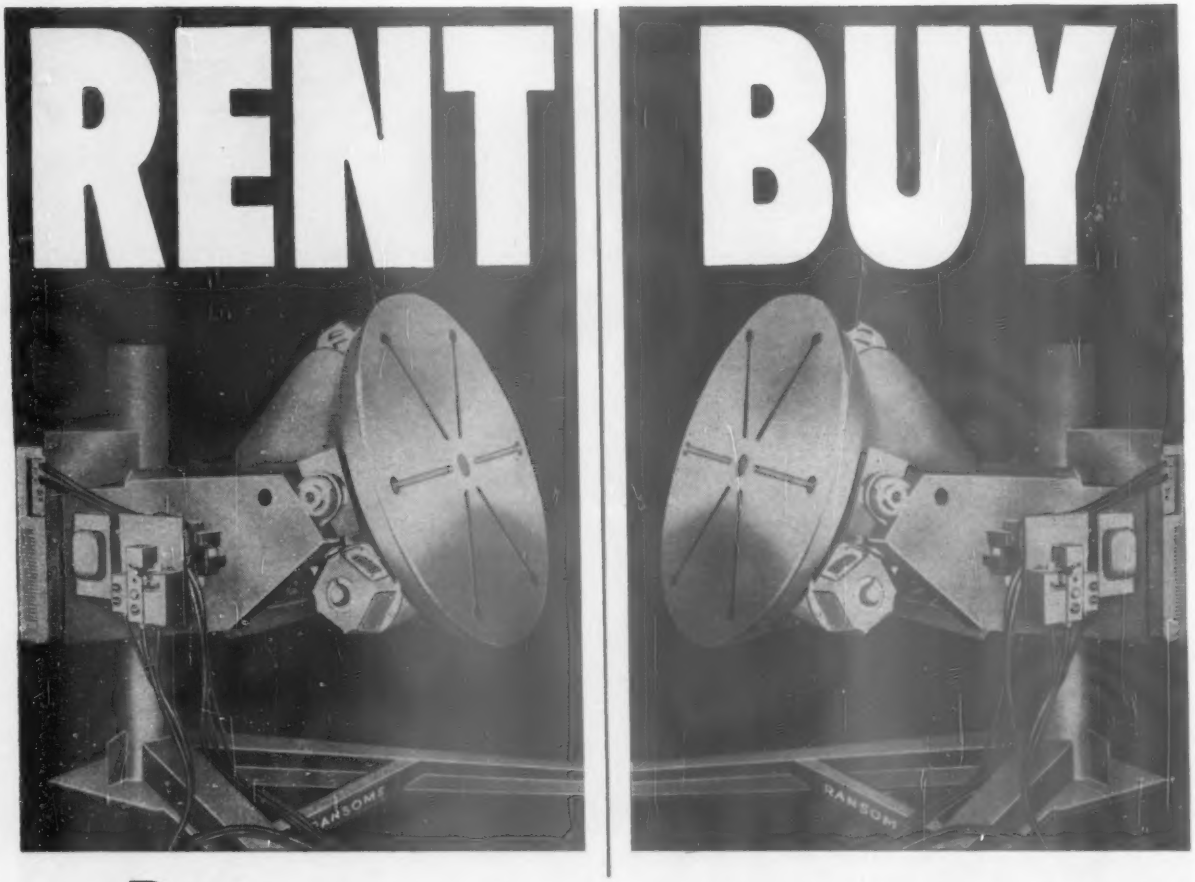

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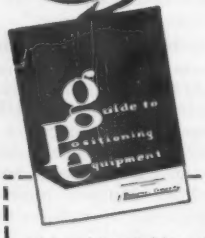

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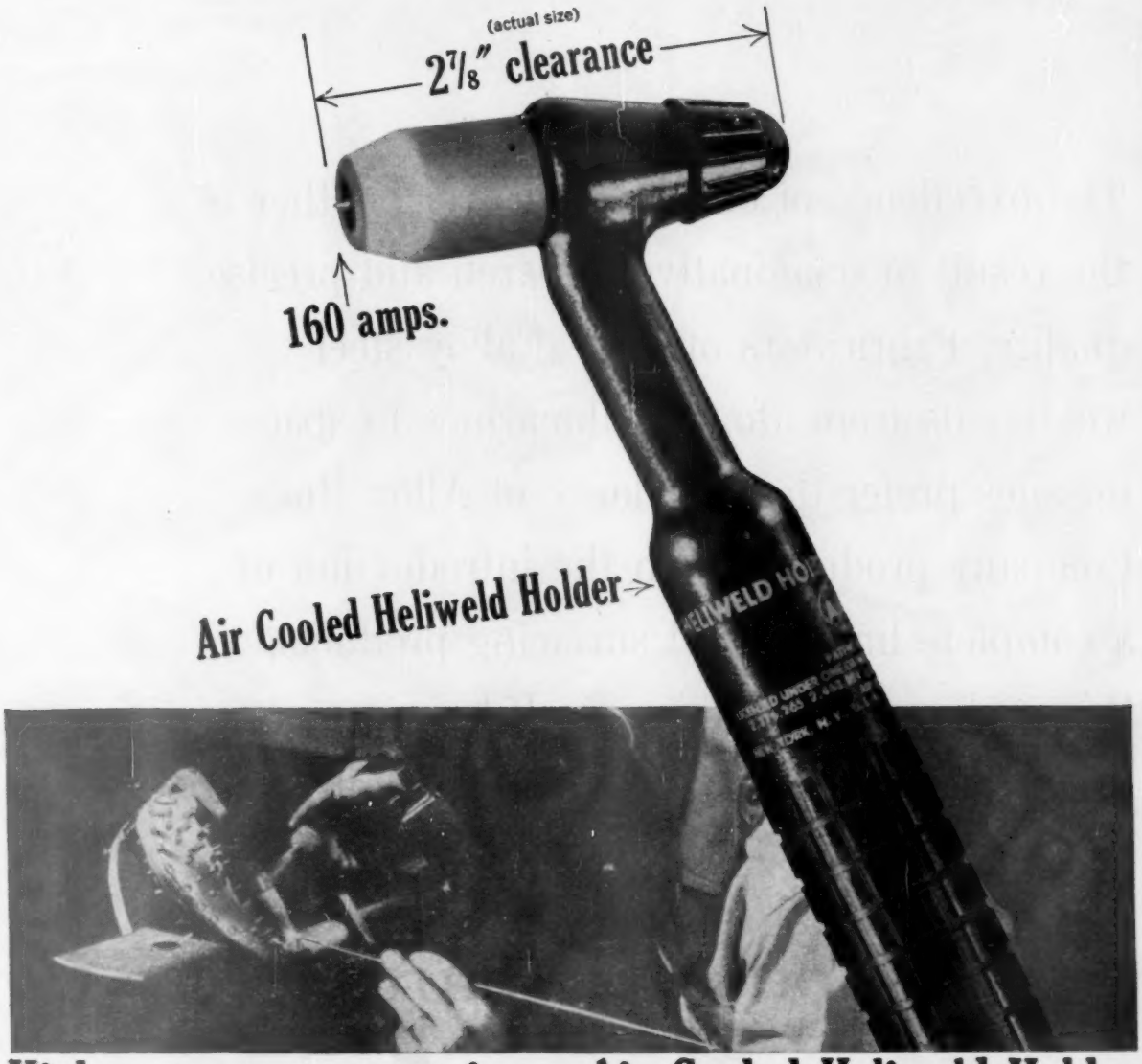

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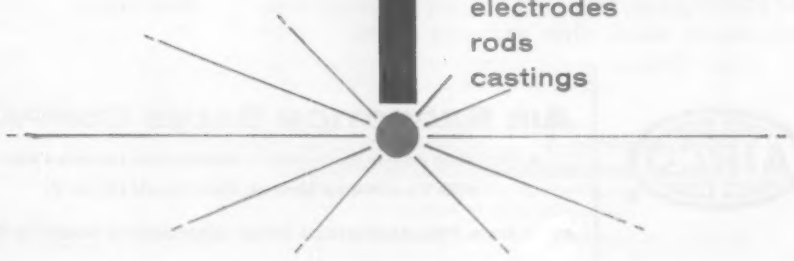
  rods
  castings



TWENTY YEARS OF LEADERSHIP IN THE DEVELOPMENT OF QUALITY ALLOY ARC WELDING ELECTRODES

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Spot Weld Easier with Tuffaloy — For Less!

NEW IDEA!
ALL ALUMINUM SPOT WELDING TIP HOLDER

It took a complete departure from previous manufacturing methods to come up with this low-cost, high quality spot welding tip holder (each is a slice of a giant aluminum extrusion). These TUFFALOY holders are corrosion resistant, carry threaded tip adapters to take the brunt of tip socket wear. For welding pressures to 1000 lbs.

THE TRADEMARKS TO TRUST
AIRCO

NEW IDEA!
PADDLE-TYPE HOLDER
USES NO 'T' CONNECTOR

A new design idea makes this TUFFALOY Holder more rugged, long-lived, and lower in cost to use—no tee connector is needed. Ideal for spot welding in restricted areas. TUFFALOY Socket-Type Tips (four nose types available) may be inserted on either side of the paddle.

Doc Tuffy says . . . be quick to use everything that improves your product or cuts your cost if you want to stay ahead of the pack . . . better get with TUFFALOY; we're coming up with the new ideas in our field.

Write or call your nearest AIRCO or TUFFALOY distributor for more information about these holders. Also request the new TUFFALOY Catalog; it describes the new RW Taper numbering system for spot welding electrodes.

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A division of Air Reduction Company, Incorporated
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Letters...

"Gadgeteering"

Sir:

I read your editorial "Industry's Apathy" with interest and am in hearty agreement with it.

The best we can say of American engineering today is that it is "gadgeteering." The Chicago Machine Tool Show was a magnificent example of numerically controlled machines. But, as *Iron Age*, in a recent issue indicated, there are very few takers.

In our engineering schools we have lost sight of the parameters of engineering as born and nurtured in a competitive economic system. The dropping out of courses concerned with fundamentals underlying production processes is the clearest clue to the fact that cost no longer need be considered as a criterion in engineering decisions. The fact that our product designs have to be taken to Europe and Japan to be produced is not an accident. The designs in some cases are so hopeless that it would be ridiculous to even consider their production at our $3 an hour labor cost unless they were to be produced in a government subsidized plant. . .

I concur with you that competitive industry better start examining the curricular programs and faculty that generate their "engineering product." Increasingly our engineering faculties come from students who have graduated into teaching without having served in competitive industry. Increasingly our deans and department heads are ones whose knowledge of the competitive environment is almost nil. The test of engineering, therefore, is the gadget. The need for process instruction cannot be understood by them.

We have extensive well equipped laboratories in the areas of materials removal, joining, forming, and casting. Our instruction will be as fundamental as we can make it, but these fundamentals will be manipulated in a real environment.

A Professor

Reckless?

Sir: *Annapolis, Md.*

The weldor on the cover of the November 1960 issue of WELDING ENGINEER is a reckless person — no gloves.

Bela Ronay
Consultant in
Welding Technology

Liquidweld ...the only cutting torch that can lick its own wounds

Liquidweld apparatus licks high-priced maintenance, labor costs and down time. If you're not using Liquidweld cutting torches, you're losing money.

Cutting torches perform rugged duties . . . and undergo rugged treatment.

Liquidweld cutting torches are built to withstand heavy-duty use. With all cutting torches, however, head seats can become damaged, causing backfiring and leaks.

Results: seat-reaming; metal-removing. In all other cutting torches, this would call for repair shop maintenance with subsequent high-cost labor and loss of use-time.

Use a Liquidweld torch and you merely drop in a replaceable mixer sleeve, right on the job. Presto! Your Liquidweld torch is ready to perform at top efficiency again.

Ask your Liquid Carbonic representative about the handy do-it-yourself repair kit that allows Liquidweld apparatus to lick its own wounds.

For complete information on torches and regulators that are as perfectly balanced as the finest rifles, send in the coupon for our new, complete catalog.

Send for your free copy of the new Welding and Cutting Apparatus Catalog No. 5900. Use coupon below. Some distributor areas still available.

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Company_____

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A *Fast Cut* To SAVE MONEY!

NEW MANHATTAN *Fast Cut* MOLDISC

DEPRESSED CENTER TYPE 27

- will remove more metal—
- grind more welds—
- get *more* work done *faster* than any other wheel of its type

Price each	SIZE	25	50	100	250
SPECIFICATION A24-Q8-BR	7 x ¼ x ⅞"	$3.46	$3.14	$2.77	$2.59
	9 x ¼ x ⅞"	4.67	4.24	3.73	3.49

Try The New MANHATTAN *FAST CUT* MOLDISC—
and *SAVE MONEY* on Your Next Job!

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RAYBESTOS-MANHATTAN, INC.

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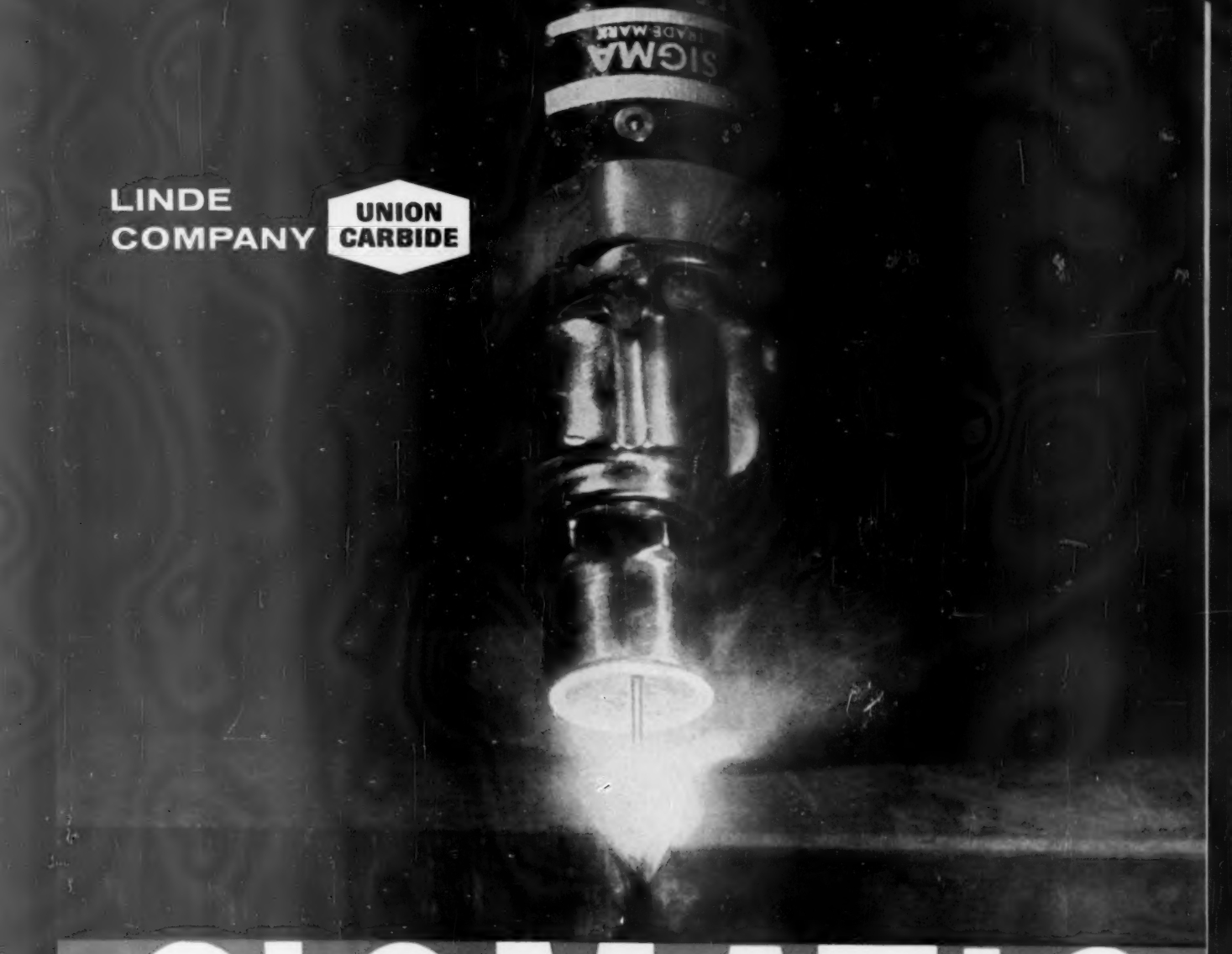


LINDE COMPANY

UNION CARBIDE

SIGMATIC

NEW ALL-IN-ONE "MIG" WELDING EQUIPMENT

Welding equipment is designed, developed and refined, but eventually it must be redesigned. LINDE'S new SIGMATIC line of "Mig" welding equipment is a product of this evolution . . . plus LINDE'S vast experience with more inert-gas and consumable-electrode processes than any other company in the world. The SIGMATIC line is the most-versatile semi-automatic equipment available anywhere—one machine for:

- **. . . all types of "Mig" welding—spray arc, short arc and spot welding**
- **. . . in all welding positions—vertical, overhead or downhand**
- **. . . with all shielding gases—argon, helium, CO_2, or their mixtures**
- **. . . and all wires—hard or soft, solid or tube**
- **. . . on all weldable metals—carbon steel, stainless, aluminum, magnesium, titanium**
- **. . . on all thicknesses—sheet metal and up**

See next page for details.

SIGMATIC

One SIGMATIC machine for... spray arc... short arc... spot welding

Spray arc, short arc, spot welding... never before combined in a single piece of equipment. SCC-8 control incorporates special spot-welding circuitry, featuring a directly-calibrated, precision weld timer and an independantly-adjustable, "non-stick" timer. Converts from spot to continuous fusion welding at the flick of a switch. SEH-2 heavy-duty wire-feed unit—largest, most-rugged unit available today—permits positive feed of all "Mig" wire types, metals and diameters. The SIGMATIC line contains five basic units, designed with interchangeable parts permitting more than 50 combinations tailor-made to individual specifications. Available in cart-, sled- or bench-type units.

Unique controls are vastly simplified. All components are visible and accessible. Adjustments can be made with a screw driver. Only heavy-duty industrial-type parts are used throughout each unit to insure dependable, long-life performance with minimum maintenance. Top-quality parts—"Square D" pneumatic timers, Mallory electrolytic condensers, Cutler-Hammer switches, Potter & Brumfield relays, Electrons, Inc. thyratron tubes. The SIGMATIC line is unquestionably a major welding advance—with one rugged, durable machine, you can do any type of "Mig" welding in any position on any thickness of any metal. For more information or a live demonstration, call your nearest Linde office.

"Linde," "Sigmatic" and "Union Carbide" are registered trade marks of Union Carbide Corporation

LINDE COMPANY UNION CARBIDE

Division of Union Carbide Corporation
270 Park Avenue, New York 17, N. Y.

WELDING ENGINEER

Your January, 1961 *Weld World*

As WE went to press, these were the industry's latest developments:

. . Resistance rail welding process, said to have "simplified controls, close regulation over weld cycle, and major improvements relating to rail alignment", will be marketed by Mobilweld, Inc., a newly acquired subsidiary of Poor & Co., Chicago, railroad supplier. The equipment can be used in fixed location or be moved from site to site.

. . Leather prices, at a peak of 34 cents a pound for light cowhides last year, dipped to 17½ cents in Chicago last month.

. . Latest entry into packaged-Mig equipment field: Machinery & Welder Corp., Skokie, Ill. Firm's air or water-cooled torches have capacities up to 600 amp, are suitable for open-arc, flux-cored or short arc applications.

. . A reduction of more than 20% in prices of metal powder stainless steel electrodes has been made by Air Reduction Sales Co. Typical cut for Zone 1 destinations: Easyarc 308 electrodes (5/32-in. diameter and 14 in. in length) have been cut from 98 cents to 78 cents per lb in 250-lb lots . . . from 97 to 76 cents in 1,000 lb lots.

. . "Significant" savings in fabrication of stronger, lighter steel structures and equipment are promised by a new low-cost alloy steel: USS T-1 Type A. U. S. Steel Corp. says the new alloy costs significantly less than original T-1 introduced in 1953, although Type A has the same 100,000 psi yield strength. In thicknesses up to 1 in., the new material matches T-1 in toughness, weldability and resistance to impact and abrasion.

. . Glenn Pacific Corp., Oakland, Calif., is the new name for Glenn Pacific Power Supply Corp. Change involves only the corporate name; personnel, policies, products, etc., remain the same.

. . Steel production reports again arouse dissatisfaction. When production dipped to 48% of capacity early last month, officials noted that publication of weekly operating rate forecast tends to give public erroneous picture of industry status. Their contention: much of today's capacity is obsolete, hence mills are using greater portion of "effective capacity" than figures indicate. As of Jan. 1, such operating rate reports were discontinued.

. . A vast new deposit of strategic molybdenum has been discovered near Taos, N. Mex., by Molybdenum Corp. of America.

. . Reports have reached WELDING ENGINEER that a combine of welding supply distributors has formed (or is forming) an organization to engineer and market a private brand of welding equipment and accessories.

for every requirement

GB

Better Silver Brazing

GB Silver Brazing Alloys are available in all popular diameters, in coils, straight lengths, pre-formed rings and special shapes to satisfy every requirement, as well as in strip form. Quality controls assure you that the alloys will produce a strong, economical, dependable leak-proof joining of metals. The alloys meet all Standard Specifications.

These popular Goldsmith alloys will join Brass, Copper, Steel, Stainless Steel, Monel, Inconel, Silver and Gold.

Your operator will appreciate your specifying GB Silver Brazing Alloys for their fine working qualities.

For best results, use GB #88 Flux, known for its low glare and low fuming qualities—operator comfort assured, available in the following size containers—3 oz., ½ lb., 1 lb., 5 lb. jars, and 25 or 50 lb. drums. Call your dealer today. Complete data on request.

Goldsmith Bros.

DIVISION OF NATIONAL LEAD CO.

900 West 18th Street, Chicago 8, Illinois—NEW YORK • OAKLAND

In retrospect . . .

(Taken from **Welding Engineer** issues of January, 1916, 1931 and 1946)

— 45 Years Ago —

The Davis-Bournonville Co. has increased the scope . . . of its Chicago branch by opening a new demonstrating plant and repair shop at 147 Austin Ave. Herman Ullmer, former assistant superintendent of the New Jersey plant, is in charge.

Always in line with progressive business organizations of the country, International Oxygen Co. has announced that this year it will inaugurate the eight-hour day at its Newark works.

— 30 Years Ago —

Effective with the January, 1931, issue, "The Acetylene Journal" is merged with WELDING ENGINEER. For over 30 years, the Journal has been the exclusive trade paper of the acetylene industry, and for 15 years, WE has been the leading business paper in the general welding field.

Victor Welding Equipment Co., San Francisco, opened its own factory branch store at 2032 Santa Fe Ave., Los Angeles, recently. J. C. Blake is manager.

Frank Longo, welding supervisor of the Southern Pacific Co. shops, acted as official guide when members of the Los Angeles section of AWS toured the railway's machine shops.

— 15 Years Ago —

Charles J. Jennings has been named engineering manager of Westinghouse Electric Corp.'s welding division. John H. Blankenbuehler has been named manager of arc-welding apparatus.

To mark the conclusion of their company's first half century in the welding business, employees of The Lincoln Electric Co., Cleveland, presented a silver plaque to John Cromwell Lincoln, who founded the business in 1895.

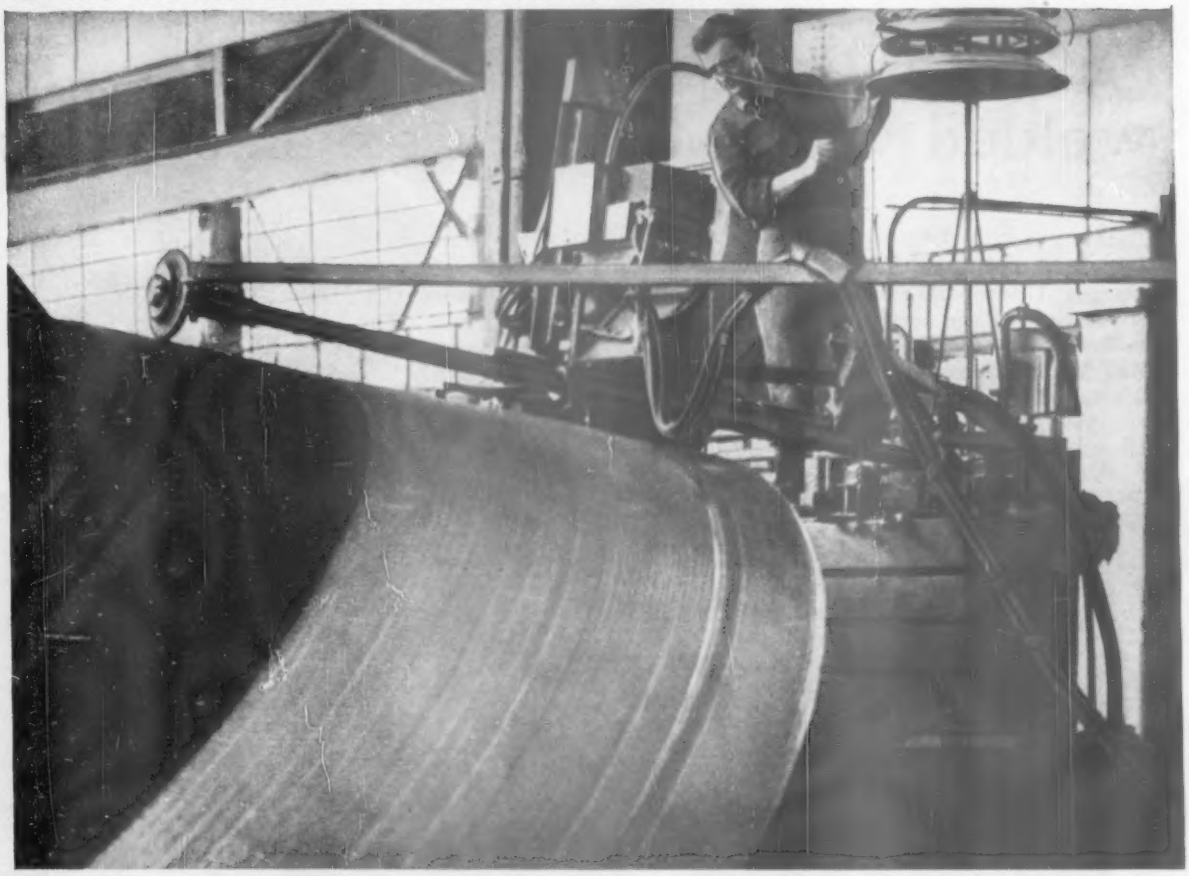
Captain V. H. Godfrey, who recently completed a tour of service in the U.S. Navy, has returned to Page Steel & Wire Div., of American Chain & Cable Co., Inc., Monessen, Pa.

World's biggest power shovel welded with M&T Murex electrodes

Picture this 6,588,000 lb. giant on the 50-yard line of a football field. It could dig a 65 cu. yd. dipper-full in one end zone, lift it 140 feet high, swing its 170-ft. boom and pile the 100 ton load on a 12-story building in the opposite end zone. For many of the shovel's most important weldments, the builder, Marion Power Shovel Co., put its trust in M&T Murex electrodes – products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

M&T MUREX
PRODUCTS FOR BETTER WELDING

METALS LIVE LONGER...WHEN HARD-FACED WITH "HAYNES" ALLOYS



Submerged-arc welding equipment here deposits HAYNES hard-facing alloys on large areas of a 15-foot diameter blast furnace bell, to resist abrasion, impact, erosion.

Hard-Facing BIG Areas... Rapidly

Many big jobs are now being hard-faced with standard submerged metallic-arc equipment—using HAYNES alloys. The advantages: high rate of deposition, up to 20 pounds per hour; large cross sections faced without pre-heating; minimum deposit dilution by use of multiple layers.

For hard-facing gyratory crushers, blast furnace bells and hoppers, crusher rolls and jaws, tractor rollers—wherever impact, abrasion, heat, corrosion, erosion are problems—HAYNES alloys in drawn-tube rod form give the desired properties. They feed smoothly and uniformly.

Many smaller-area hard-facing jobs, too, are being done faster and at lower cost, on a production-line basis. Whether you hard-face large areas or small—whatever your hard-facing job is—it will pay you to insist on HAYNES rods. Our field engineers will gladly help you solve your hard-facing problems. Write us today!

HAYNES
ALLOYS
HAYNES STELLITE COMPANY
Division of Union Carbide Corporation
Kokomo, Indiana

UNION CARBIDE

Address inquiries to Haynes Stellite Company, 270 Park Avenue, New York 17, N. Y.

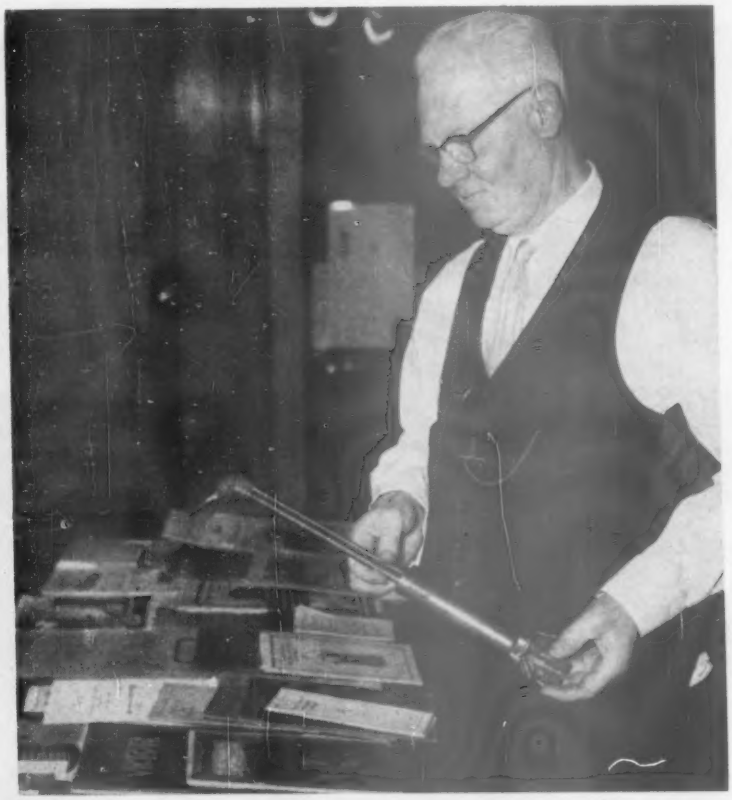
"Haynes" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

World's tallest structure relies on M&T Murex electrodes

Almost 1000 tons of steel stretching 1676 feet into the sky! This new television transmission tower for KFVS-TV, Cape Girardeau, Missouri, is the tallest structure man has ever built. It's 204 feet taller than the Empire State Building, has solid steel legs up to 7½" in diameter, can withstand winds of over 100 mph. In welding the 30-ft sections of this triangular tower of strength, Dresser-Ideco Company put its trust in M&T Murex electrodes... products of METAL & THERMIT CORPORATION, Rahway, New Jersey.

M&T MUREX
PRODUCTS FOR BETTER WELDING

Between passes



HOLDING one of many torches in his collection is Ted Russell. Several of the torches were built in 1908 and 1910. On table in front of Mr. Russell is just part of his library of old catalogs and manuals, some of them also dating back to 1910.

Senior subscriber Ted Russell started reading WE in 1917

A retired Oak Park, Ill., man is WELDING ENGINEER's senior subscriber. He is Theodore W. Russell, who started receiving this magazine in January, 1917, exactly one year after its founding by the late L. B. Mackenzie.

Mr. Russell began his welding career in 1910. The last 41 years of his active career were spent with International Harvester Co. When he retired early in 1955, he was supervisor of welding research for that firm.

In addition to having all issues of *WE* since 1917, Mr. Russell has a large library on welding of which he is justifiably proud. He says it contains every book ever published on welding.

At the same time he became a subscriber to WELDING ENGINEER, Mr. Russell began reading *The Acetylene Journal*, which was merged with *WE* in 1931.

An avid booster of welding, Mr. Russell told us he enjoyed his work as a weldor and welding supervisor. He said, "Welding offered me a very good opportunity . . . and there is as much opportunity for youngsters today, if they will apply themselves to welding and provided they aren't afraid of work."

Mr. Russell still keeps busy in his retirement. His hobbies include gardening, woodworking, traveling with Mrs. Russell, and listening to classical music, "especially on today's modern equipment."

MR. REEVES

E. B. Reeves, Reeves Welding & Machine Work, Raymondville, Texas, began subscribing in 1922, although he has read WE since 1920. Mr. Reeves has generously credited WELDING ENGINEER with contributing ". . . a greatly appreciated welding knowledge to my existence as a machine shop operator . . . for over 30 years."

George Allard of Birmingham, Ala., recently renewed his subscription which has been in effect continuously since 1925.

K. S. Walker of Milwaukee has a copy of our February, 1926, edition, and he hasn't missed an issue since that time.

Wilbert Davis of Minneapolis has been a subscriber since April, 1928, and tells us he has "gained much by reading WE."

Charles Peters, a welding instructor at the University of Wisconsin, Madison, has been a reader since January, 1928, and has a complete library of every edition from that date.

Frank A. Longo of Redwood City, Calif., has been reading WELDING ENGINEER since the 20s and in those days also read *The Acetylene Journal*. He recalls that "we on the Southern Pacific started welding and cutting in 1915 and soon after that began receiving . . . *The Acetylene Journal*." Later, he subscribed to *WE* and recalls that we had a West Coast representative named

W. E. Archer, now a welding supply distributor in Pasadena, Calif. Mr. Archer started reading *WE* in August, 1929, and has a complete file of each issue from January, 1930, to the present. In the early 30s he served *WE* as its West Coast reporter.

Robert Burns, Burns Welding Shop, Montezuma, Ind., is another reader who has kept all issues of *WE* since first subscribing. His subscription started in 1931.

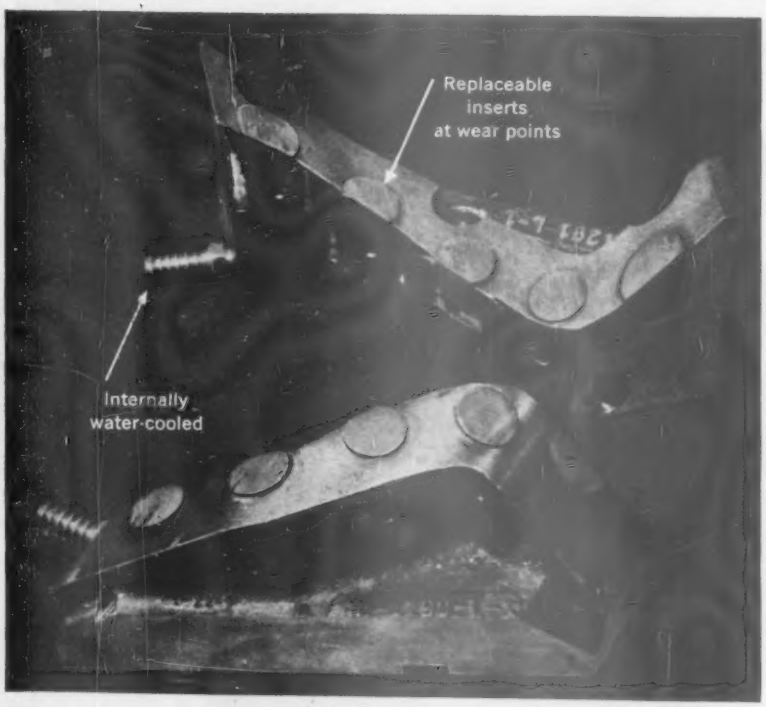
Biggest U. S.-built ship welded with M&T Murex electrodes

The *Princess Sophie*, built by Bethlehem Steel Company, has the latest electronics, a foam fire-protection system, a fully equipped hospital, air-conditioned quarters—all making this one of the safest and most luxurious supertankers ever built. When loaded, it has a greater displacement (100,000 tons) than any passenger or military ship afloat. In building the Princess Sophie, welding was with Murex electrodes—products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

M&T MUREX
PRODUCTS FOR BETTER WELDING

AMPCO®

7 times longer life for projection welding die!



Replacement time and cost reduced almost 75%!

Originally, the projection welding die shown here was cast to contour in one piece and not internally water-cooled. Its life was short. Replacement was expensive, in terms of both money and downtime.

Then Ampco's experience was drawn upon. Working surfaces were changed to incorporate relatively inexpensive refractory inserts which could be quickly replaced. Adequate water-cooling was provided, also. These two factors vastly increased die life.

Ampco has complete facilities and the know-how for making welding dies of all types — flash, butt, projection, and cross-wire. Your Ampco-Weld distributor can put them to work for you. Call him. Write for Bulletin RW-10.

RESISTANCE WELDING ALLOY ASSOCIATION

RW-28C

AMPCO METAL, INC., Dept. 187A, Milwaukee 46, Wis.
West Coast Plant: Huntington Park Calif. • Southwest Plant: Garland (Dallas County), Texas

Book Reviews

Electric motors

IEC PUBLICATION 72-1. Published by the International Electrotechnical Commission. Price $2.40.

This publication constitutes the first part of the third edition. Previous editions were status reports of progress toward standardizing those electric motor dimensions affecting interchangeability.

The book gives a new international standard recommendation for electric motor dimensions and output ratings. It deals with foot-mounted a-c induction motors with shaft heights between 2⅝-in. and 12½-in. (56mm and 315mm) for voltages up to 600 volts and frequencies of 50 and 60 cps (Hz). Book includes standard dimension tables, shaft extensions, and output ratings for these motors.

Boiler design

PRESSURE VESSEL AND PIPING DESIGN. Published by The American Society of Mechanical Engineers, New York City, 1960, 700 pages. Price $10.

This collection of fundamental information for boiler, pressure vessel and piping system designers was compiled from technical papers and reports published between 1927 and 1959. Sections deal with openings, bolted-flanged joints, heads, shells, piping, materials and fabrication, thermal stress and fatigue, loads and supports, external pressure and miscellaneous topics.

Information is intended to be helpful to designers, but it is not to be construed as a supplemental requirement to the Society Codes.

Aluminum pipe welding

RECOMMENDED PRACTICES FOR GAS SHIELDED-ARC WELDING OF ALUMINUM AND ALUMINUM ALLOY PIPE. Published by The American Welding Society, New York City, 40 pages. Price $2.

Prepared by the AWS Committee on Piping & Tubing, the booklet covers all aluminum pipe welding phases from processes and machine settings to welding techniques and heat treatment.

A conversion table is included listing ASTM alloy designations and corresponding commercial al-

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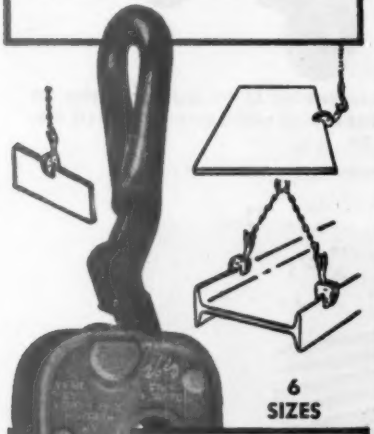
YOUR BEST MOVE . . . MOVE with MERRILL MATERIAL HANDLING DEVICES FOR THE MOST IN Safety and Economy

Imitated, but never duplicated, Merrill Lifting Clamps are Drop Forged to give you Safety in Handling and Economy in Operation.



6 SIZES

FEATURING THIS MONTH

MERRILL DRUM LIFTER

Over 25 Material Handling Devices described in our catalog C-2.

Ask for a copy.

MERRILL BROTHERS
Producers of Drop & Press Forgings
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loy numbers adopted by the Aluminum Association. Another table recommends filler metals for welding different combinations of aluminum alloys. Further tables indicate actual settings (current, gas flow, number of passes, etc.) required for various pipe sizes and thicknesses.

Pressure vessels

UNFIRED PRESSURE VESSELS. By Robert Chuse. Published by F. W. Dodge Corp., New York City, 149 pages. Price $8.75.

This enlarged, revised fourth edition includes 66 tables, charts and diagrams permitting quick, accurate calculations for designing, ordering, fabricating, inspecting and repairing unfired pressure vessels.

Not a text-book, but a practical guide for consulting mechanical, chemical and design engineers, and for fabricators, inspectors, shop supervisors and users of Code vessels, this book by a WE contributor recounts the ASME Code history, outlines procedures for obtaining Code authorization, presents Canadian pressure vessel requirements, indicates necessary welded repair procedures and highlights such factors as work-flow schedules, mill orders, warehouse orders and shop organization.

Brazing filler alloys

DEVELOPMENT OF PARTIALLY VOLATILE BRAZING FILLER ALLOYS FOR HIGH-TEMPERATURE APPLICATION AND RESISTANCE TO OXIDATION. By W. M. Lehrer and H. Schwartzbart. Published by Office of Technical Services, U. S. Department of Commerce, Washington, 1960, 45 pages. Price $1.25.

This report describes experimental brazing filler alloys developed containing temperature depressants which can be volatized during stainless steel brazing to leave high remelt temperature joints. With alloys containing nickel, chromium, germanium, iron, lithium, and phosphorous, the two main mechanisms used were base metal dissolution in the filler metal and constituent diffusion of the filler metal into the base metal, and filler metal constituent volatization.

Of the materials tested, the Ni-Cr-In-Ge alloys and the Ni-In alloy proved most practical for high-temperature usage. Among several vapor removal methods tested, vacuum pumping was found most efficient.

Largest Shovel

Tallest Structure

Biggest Tanker

Here are three fine achievements with steel . . . shovel, tower, ship . . . each a leader, each welded with M&T Murex electrodes.

Dozens of demanding jobs like these . . . and hundreds of everyday applications . . . have established the Murex reputation.

When you think of electrodes, think of your M&T Murex representative—a specialist with a wealth of background and training to put at your service. Or look into the Murex Electrode Selector for a complete listing of over 1000 Murex types and sizes. Copies available from: METAL & THERMIT CORP., Advertising Dept., Rahway, N. J.

M&T MUREX welding products
METAL & THERMIT CORPORATION
General Offices: Rahway, New Jersey

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6 miller WELDERS YOU SHOULD KNOW ABOUT

AEA-200-L gasoline engine driven welder/power plant/pipe thawer. 225 amperes welding current; 1 KW of 115v d-c; 5 KW of 115/230v a-c.

AD-225-L gasoline engine driven AC/DC welder/power plant. 300 amperes a-c or 225 amperes d-c welding current; 7 KW of 115/230v a-c; 1 KW of 115v d-c.

Gold Star SR Series, 3 phase rectifier type d-c welders in four models from 200 to 600 amperes. This is probably the most reliable, versatile and best performing all-around welder ever designed.

SRH — The famous Miller Gold Star series in a low silhouette welder for stacking, paralleling or to conserve space.

250 AC/DC combination transformer rectifier welder. Operates from single phase service to bring new standards of welding performance to everyone. Two a-c and two d-c ranges.

M-295 — new wide range a-c welder of horizontal design. Two welding ranges of 25-115 amperes and 80-295 amperes which handle all metals from light gauge to heavy plate.

Complete specifications on any of the above illustrated Miller welders will be sent promptly upon request. Also available are free copies of "A Full Line of Fine Welders" — a booklet illustrating and describing all our welders.

miller ELECTRIC MANUFACTURING COMPANY, INC. • Appleton, Wisconsin

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

JANUARY, 1961
OUR 45th ANNIVERSARY YEAR

Welding Engineer

ESTABLISHED 1916

This (and every) year's task

THE NEW YEAR has a special meaning for us; with this issue WELDING ENGINEER begins its 46th year of service to the welding industry.

In 1916 welding was viewed as a little-used maintenance process. Today it has become an indispensable part of our everyday living. During this four and half decades, we have reported nearly all the developments of this growth.

You, as readers, are fully aware of welding's importance; our big job is to pass this awareness on to the general public.

Too often, the public is made aware of welding only by such happenings as the recent disastrous aircraft carrier fire, which took at least 48 lives and which probably will be blamed on welding.

True, welding has caused fires — but apparently in this case proper precautions were being taken. How could a welding crew know that 500 gallons of jet fuel would be stored where it could flood a welding area, or that a truck would puncture the tank?

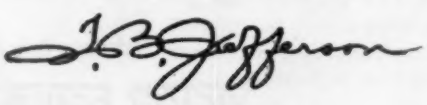
On the brighter side, the cost of this fire can possibly be reduced and reconstruction speeded if flame-straightening is considered for re-aligning the buckled plates and twisted structural members.

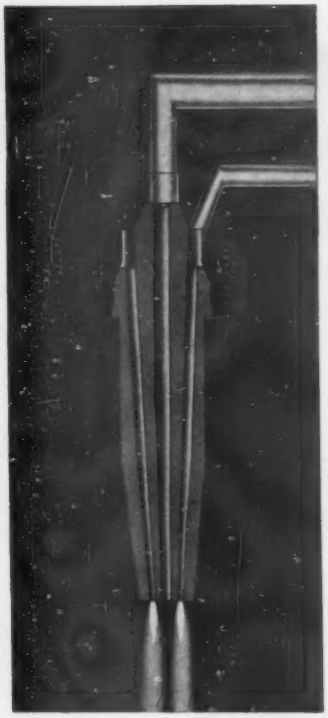
Where it has been used, this process has produced almost miraculous results. If given the opportunity, it might do it again — *and possibly give the welding art some proper publicity.*

For 45 years *WE* has been devoted to the promotion of modern means of joining and severing of materials. While not everyone agrees with our opinions, there are few who will deny that WELDING ENGINEER has the good of the welding industry at heart.

Welding has come a long way since 1916 and we are happy to have had the opportunity of playing a small role in its advancement. We are grateful to those who have helped us in this task, particularly the seven companies whose advertisements have appeared regularly since our beginning.

The majority of the 45 years have been good. It is our hope that the years to come will be good to both you and us.





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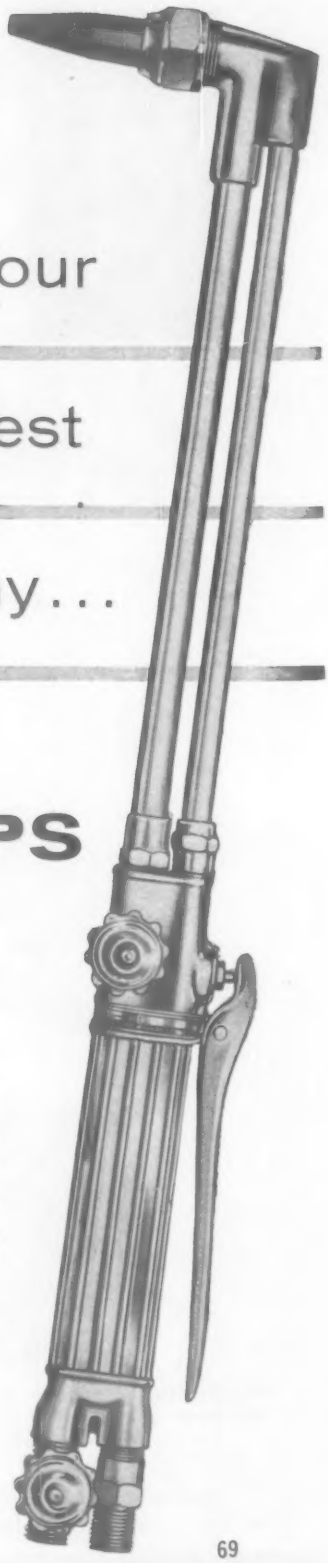

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69

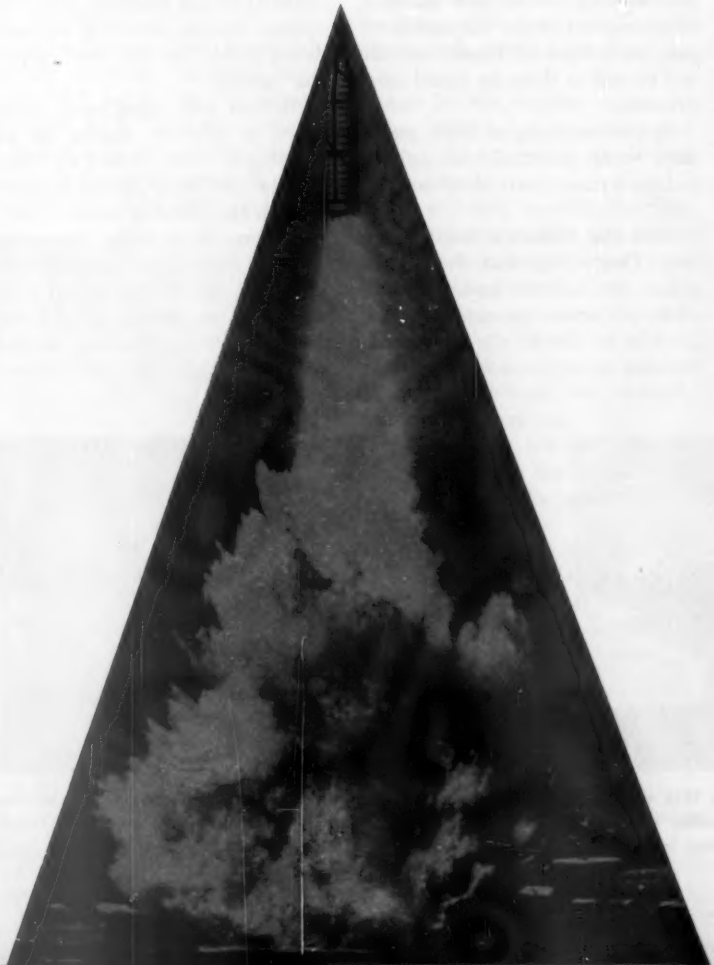
Welding
Engineer

45

YEARS OF WELDING

. . . from the blacksmith era

. . . to the space age



WELDING HAS COME TO BE a most important branch of mechanics. By means of welding by one of the several processes whole industries have been revolutionized . . . We may confidently expect the field to expand . . .

No, these words weren't written two weeks ago, they were written 45 years ago by WELDING ENGINEER's Founder L. B. Mackenzie for the cover editorial of our initial issue.

Since that time welding's growth has been steady, at times explosive. Mr. Mackenzie's confidence that it would expand can be echoed today, for welding is still a growing industry.

Chronologically, welding is as old as metal development. Even today's fusion welding had its beginning in discoveries dating back more than 100 years. Priestly, Scheele, Davy and others anticipated future developments.

But the real start of fusion welding dates back to 1885 when de Bernardos invented the process of electric welding.

Three years later, with Elihu Thomson's patent, resistance welding had its start. And in 1900, Fouche and Picard developed the first commercial oxyacetylene torch to put gas welding into the industrial picture.

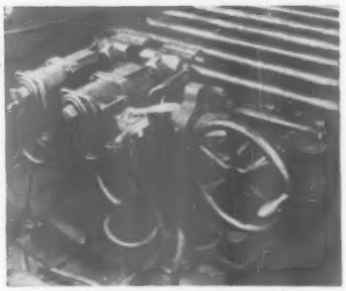
Despite these developments, the various welding processes did not receive extensive use until about 1906. Then, 55 years ago, the processes were brought out of the laboratory and put to commercial use.

Founded before the turn of the century, the International Acetylene Association envisioned new fields for acetylene use in 1909 — even automatic welding and cutting. (The IAA's official publication was *The Acetylene Journal*, also founded in 1898, which merged with WELDING ENGINEER in 1931.)

The optimistic view was based on calcium carbide and oxygen production being high enough to meet industrial demand. (Until then, oxyacetylene welding had a slow growth because the gases could not be produced in sufficient volume.)

Despite these advances in commercial use and availability, another 10 years slipped by before the metal joining and cutting processes received any attention other than from just a handful of persons in the metal-working industry.

Resistance welder nears 75 years of continuous use



MORE THAN 70 YEARS AGO this resistance welder began joining pipe coils for heating and refrigerating applications — and is still being used today.

The Rempe Co., Chicago, bought the welder in 1896. Originally designed and manufactured by Thomson Electric Welder Co., Lynn, Mass., the unit is a floor-mounted, manually-controlled butt welder rated at 24 kva.

According to Rempe officials, the original work dies are still functioning well and guide rails for the movable platens were replaced for the first time about 18 months ago. Circuitry has held up better than anyone had anticipated at that time.

Rempe personnel frequently speculate on the total footage of pipe welded with the unit. Estimates range as high as one billion. Whatever the figure, a good percentage of the welded piping is contained in some notable Chicago structures, *e.g.*, the Stadium skating rink, Union Station's water chilling system.

It was then that Mr. Mackenzie decided welding should receive nationwide attention. His lectern: WELDING ENGINEER.

Gas and arc welding as production tools did not receive widespread approval until after World War I. When the United States entered that war, only resistance welding was used in production, arc and gas welding being considered primarily maintenance and repair tools.

But they helped win the war. Enemy merchant ships, sabotaged in our ports, were repaired and returned to service for the Allies in less than nine months. Repair of intricate castings were greatly simplified by welding. "Irreparably damaged" ships quickly left the shipyards for continued service. Flame-cutting, however, did gain importance as a production tool.

By the end of the war, arc and gas welding were also gaining. Shipyards noted the successful repair work done by these methods and turned to them for initial construction.

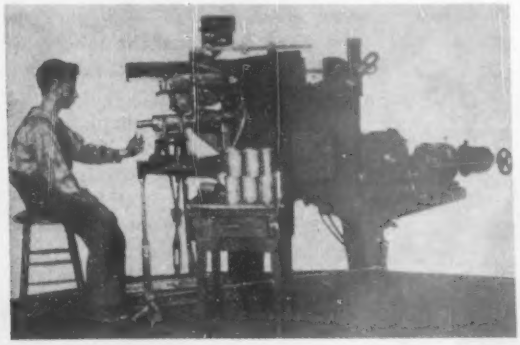
By the beginning of 1919, many ships were practically all-welded and gave many years of service.

With the Armistice, the Emergency Fleet Corp. lost its official status. But industry leaders decided to perpetuate its objectives, so in March, 1919, the American Welding Society was founded.

In the post-war years, more modern welding methods were developed.

The idea of using a shielding gas in the arc zone dates back to about 1890. The gas proposed then was carbon dioxide, which is currently being hailed as the "new" shielding medium.

Helium and argon were recognized as effective shields for arc welding in 1920. Hobart and Devers obtained basic patents for inert-gas shielded welding using a refractory electrode in 1930. (First commercial application is usually credited to Northrup Aircraft who used it on magnesium assemblies in 1940. In 1948 a practical method of feeding a reel-wound consum-



MOTOR-driven seam welder (left) was new in 1916 when built by Toledo Electric Welder Co., Cincinnati. Machine welded 12-in. seam in five seconds. Oxyacetylene welding (right) joined

pipe sections near McDonald, Pa., in 1916 for what was then the deepest well in the U.S. — 7,181 ft. Today's wells reach into the earth more than 25,000 ft.

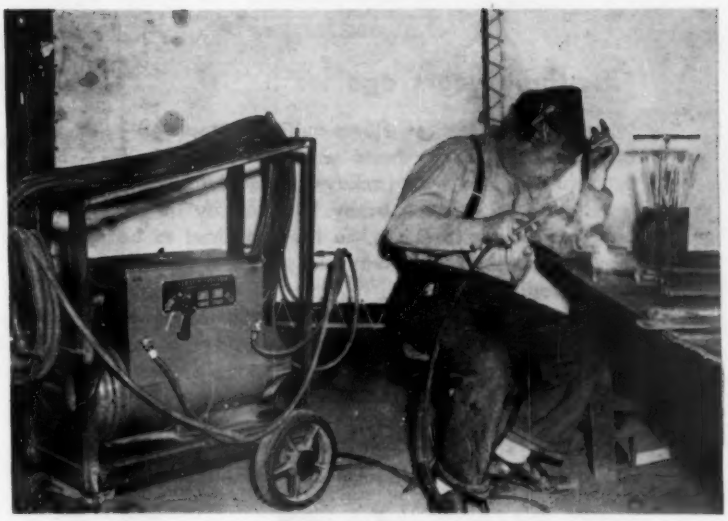
able electrode into an inert-gas zone was introduced.)

During the Roaring Twenties, welding was gaining status as a production tool in more and more industries. New applications were being discovered for welding equipment.

Early in the 20s use of welded pipelines was expanded, as was resistance welding in the automotive industry. By the middle of the decade gas welding of tubing in airplane fuselages was common practice, even though prohibited in England and France. With the growth of the aircraft industry and the introduction of hardfacing in the oil field, gas welding received new impetus.

Another development of the 20s was the coated electrode. Slightly rusted bare-wire electrodes had been known to give better results, so experiments with coatings followed. (But experimentation was slow, *e.g.*, Kjellberg was granted two patents, one in 1907, the other in 1912, which described electrode materials, coatings and minerals for slag formation.)

Solid electrodes with extruded coatings were not produced until about 1925 and not for commercial use until 1929. With the success of coated mild-steel electrodes, industry began experimenting with coatings for other types such as aluminum and stainless.



WELDING played an important part in both fabrication of new materials and in maintenance of operating equipment during World War II at the Lockheed Aircraft Corp., Los Angeles. Welder is using a GE power source for maintenance work at the then vital defense plant.

In the early 30s metal-arc welding grew rapidly as design engineers and architects gave it more thought for application in building and bridge construction, as well as in other structures. In 1931, codes for power boilers and unfired pressure vessels were adopted.

And by the middle of the decade, welding had contributed much toward a better standard of living. Items:

¶ It had made possible the tight one-piece construction of refrigerators, washing machines and other household appliances.

¶ It had improved radio reception through resistance welding of tube filaments.

¶ It had lightened, yet strengthened, the automobile.

The welding industry was not exempt from the depression of the 30s, but it quickly recovered and continued its climb.

In answer to an increased demand by structural fabricators and shipyards for a faster means of welding heavy plate, submerged-arc welding was introduced in 1934.

OUTSIDE or inside, the nation's defense effort depended heavily on welding, as in this case where a spot welder was suspended from a crane to join engine components on the Navy's Martin Mariner.

Used both semiautomatically and automatically today, submerged-arc welding proved the solution to this demand for speed. More automatic welding and motor-driven cutting machines were also being developed.

Then came World War II.

Ships for materials and troop movements, tanks, planes, guns; everything made of metal was welded during the war.

The all-out effort stimulated research and a satisfactory coated electrode for use with a-c welding sources was developed. Even though the coated electrode had been introduced in the late 1920s, very little of this type welding was done prior to the war.

Until 1940, most arc welding was done with d-c (motor-generator) sets, often using bare-wire electrodes. Since the war, a-c welding has dominated the scene, although the success of d-c rectifier power sources has shaken the a-c throne.

Another wartime development was the low-hydrogen electrode for joining low-alloy steels. The addition of iron powder to electrode coatings has been still another step in the never-ending attempt to improve the welded product. And the combining of the low-hydrogen-type coatings to the iron-powder

Fifty-three years ago . . .

. . . the first test of flame-cutting compared with hack saw cutting by hand was conducted by W. F. Schaphorst, then with Lackawana Steel Co.

Pilings had become badly battered by the steam hammer driving them in, so the tops had to be removed. The hack saw was the principal tool and it was a tedious job.

Flame-cutting was not "bad," but it had one disadvantage; the flame would continuously go out, requiring many re-lightings. So a comparative test was run to determine which method was better.

Schaphorst does not recall the exact results, but he states: "The flame method came out on top despite the continual extinguishing of the flame."

electrode has proved an even greater success.

Tig and Mig welding have proved most effective in joining thin-gage nonferrous materials. And the use of carbon dioxide as a shielding medium for Mig has broadened the scope of that method to include welding of mild steel.

Further refinements in power sources and equipment have made CO_2 welding a trusted production tool in the automotive and other industries.

In the past few years WELDING ENGINEER has reported some new developments in welding which even the most foresighted of the industry's pioneers did not, nor could not, envision. Items:

¶ **Electroslag welding,** credited to Russia and Czechoslovakia, is an arc-less process in which an electric current flows through a pool of molten slag. The resistance of the slag to current creates a high heat which melts both filler and parent metal to make a weld.

¶ The **electron-beam** process uses a controlled high-density stream of electrons to change matter physically or chemically. The stream of electrons is directed at the work piece; the material is heated, melted or vaporized depending on the energy density in the beam.

(Studies have shown that electron-beam welding offers the best answer to present-day welding problems of refractory metals and is fast becoming a major tool in aircraft and missile fabrication.)

¶ **Plasma heat** welding is the result of electrically heating a gas to such high temperatures that its molecules become ionized atoms containing high energy. The arc current is restricted and resistance increases.

The resulting pressure and forces then cause ejection of the plasma in a stream or jet at temperatures up to 60,000 F which can be used to weld or cut ferrous and nonferrous metals.

¶ **Explosive forming** and welding of metals is done by immersing the work piece in a force-transferring media (water, talc, clay, plastic) and detonating an explosive charge. The advantages of only one die, extremely close tolerances, no spring-back and improved properties illustrate why this method has been so extensively adopted in the missile field.

¶ **Explosive cutting** and hardening were inevitable after the furor created by the above process.

Although the development of acetylene chalk is still anticipated, the next best thing today is a flexible sheet-explosive which can cut or harden metals. The sheet is easily cut with a knife, easily applied, safe in all respects when properly handled.

Detonated by a high-power electric blasting cap, the explosive cuts the metal in the shape in which it was adhered to the metal. Placing the explosive directly on the metal's surface, the shock wave hardens metals up to 2 in. below the surface, increasing Brinell hardness some 300 points.

¶ **Friction welding** (see p. 39 this issue) is a method of butt welding in which joint faces are brought to welding temperature by rotating one against the other while under pressure. Main application, as used by the Russians, is for butt welding circular bar.

However, much work is also in progress on thick-walled tubing. Stud welding is still another possibility, provided the plate thickness is not more than one-fourth the stud diameter.

Refinements in flame-cutting, other than the electron-beam and plasma arc processes, include electronic tracing and cybernetics.

¶ The **electronic tracing** unit can follow the exact center of any line 0.040-in. wide or less, the tracing head remaining within 0.005 in. on either side of the scanned line.

Extending this principle of electronic tracing is cybernetics, in which the original drawing is reduced photographically 10 times so that a 1/100 glass negative results. This slide is then projected to a pilot scanning machine and a feed-back servo-mechanism connected to the flame-cutter.

¶ Using energy produced by high frequency sound wave, **ultrasonics** are being used more and more to weld thin-gage metals in both the aircraft and missile field.

What does the future hold for the welding industry? All that a welding engineer's imagination will allow.

We could speculate on atomic welders with small nuclear reactors supplying the power.

We could theorize on man's first attempt to weld in space.

But your imagination is as vivid as ours. Think of the possible and probable advances to be made — then watch as the welding industry transforms these thoughts into solid workable fact.

Some of these thoughts, as expressed by leading welding engineers, start on page 52.

by D. H. Hawes
General Supervisor
Welding Development
Caterpillar Tractor Co.

An earthmoving equipment manufacturer examines and evaluates each welding power source against a prescribed testing procedure—and finds some units lacking

How to select and use proper welding power sources

IN MANUFACTURING EARTHMOVING equipment, a great portion of the final weight of the product is fabricated.

The goal: less expensive manufacturing while maintaining satisfactory strength and quality in the end product. The solution: welding.

For Caterpillar's welding applications, light duty, engine-driven 220-volt units and power sources are used in the maintenance department for repair work. All production welding is performed with heavy duty or industrial welders using 460-volt input power.

Where reasonably good fit-up is possible and where joints generally can be positioned horizontally or flat, semiautomatic d-c welding is used because of its high deposition rate.

When these conditions are present on high production parts, automatic welding is utilized. Most of these units have voltage adjustment to vary the amp-voltage relationship.

The welding processes used are submerged-arc, Mig and CO_2 — Mig Conveyor feed rolls, welding head movement, wire-feed stop and start, and flux or gas flow can be engineered to enable full automatic welding. Only the loading and unloading of the conveyor and slag removal is manual.

Naturally, electrode wire, gas or flux, and the proper current must be supplied to the unit, and the high currents required necessitate large heavy-duty power sources or multiple smaller units placed in parallel.

With the a-c/d-c welders, direct current for tack welding and semiautomatic welding can be used, and alternating current can be used where arc blow is encountered or with iron-powder open-arc electrodes.

At Caterpillar, a satisfactory power source, either transformer or generator type, must be capable of producing high quality welds while requiring only a minimum of maintenance. In case of breakdown, the unit should be both easily accessible and repaired.

Breakdowns are costly because of the production loss and the cost of labor involved to replace and repair the welders. Failure of a 25-cent part could involve considerable production loss of man hours and final product.

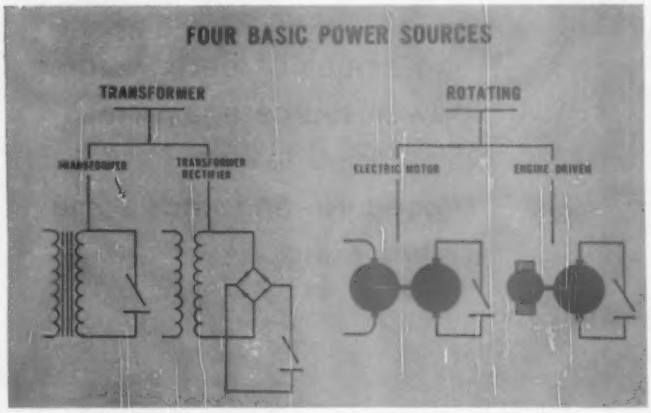
The cost of consumed electric power to operate the

Characteristics of

THE FIRST STEP in setting up a welding operation is selection of proper size and type power sources.

There are only four basic types of power sources: transformer; transformer and rectifier; electric motor generators; and engine driven generators. These can be placed into two groups — transformer or rotating means of producing welding current.

The transformer type is a simple means of producing a-c current without moving parts. By adding rectifiers it can be converted to d-c, and chokes or smoothing reactors can be used to improve the d-c wave form.



The electric motor generator with stationary field produces direct current and is powered by normal 220 or 460 volt current. The engine driven generators with a rotating field can produce either a-c or d-c and are used where electricity is not available or where portability is mandatory.

Direct current generators usually have better wave forms and are less affected by line voltage variation than transformer types.

Four methods of current control are possible on the transformer type welders:

✓ **Tapped secondary.** Vary the number of transformer secondary turns by inserting the welding lead in different plugs which are connected to the secondary. This permits a different amperage to be produced for each plug, but also varies the open circuit voltage. Used in light duty or farm welders.

✓ **Tapper reactor.** The number of transformer secondary turns does not change. A winding is placed around an iron core with various taps or plugs to enable reactance variation which changes the amperage but not the open circuit voltage.

✓ **Stepless manual control.**

(a) **Moving coil.** The transformer primary or secondary is moved by a hand wheel either nearer to, or farther from, the other winding to enable stepless amperage control. On some models the hand wheel is powered by an electric motor.

(b) **Moving shunt.** A movable iron shunt is placed in the magnetic field of the transformer. By moving the shunt and consequently varying the strength of the magnetic field, the amperage can be varied. Both moving coil and moving shunt are used by heavy industry.

✓ **Remote control** (either by a rheostat or remote control receptacle). A saturable reactor is placed between the transformer secondary and the welding electrode with the reactance controlled by an adjustable direct current. Using a tapped reactor and a rheostat, adjustable low, medium and high ranges can be provided. This type is also used by heavy industry.

Alternating current power sources have a conventional drooping voltage characteristic, while d-c power sources can have one of three voltage characteristics.

● **Drooping or constant current.** The ampere times the voltage

power sources is not as important as the welding ability or the maintenance characteristics of the welder, but it is still worth considering.

Because of economic factors, three phase current for d-c power sources should be used when available. Power factor correction capacitors are desirable to minimize the load kva charges (capacitors increase idle kva demand, but required kw is unchanged).

The power sources should also have a reasonably high electrical efficiency to obtain reasonable power costs. Initial cost of the power source, when within reason, is less important than the other features of a welder.

To facilitate comparison of various power sources, testing equipment was acquired, a testing procedure was developed and power sources were checked and evaluated on a point system.

An adjustable resistance load bank with 1,000 amp capacity was obtained to simulate a welding load.

Power source leads were connected to the load bank terminals, and both input and output voltages and amps were checked.

Kilowatts required were determined by use of a recording watt meter.

Each welder was examined and tested to determine the controls present, welder characteristics, safety devices, welding ability and maintenance indications.

The following observations and evaluations were made and recorded on a standard form for each transformer, transformer rectifier and m-g power source:

1—*General information*. Data on welder manufacturer; model and serial number; percent duty cycle, whether single or three phase; a-c, d-c or a-c/d-c unit; type of rectification for d-c; amperage range specifications and power factor correction presence.

remains the same for one setting. A decrease in voltage causes an increase in amperes. The high open circuit voltage enables starting the arc and the reasonably high short circuit amperes discourage freezing the electrode to the work. Hand or open arc welding requires this type.

● **Constant arc voltage or constant potential.** The welding voltage remains constant even though arc length or amperes varies (actually the voltage decreases slightly when the amperage is increased).

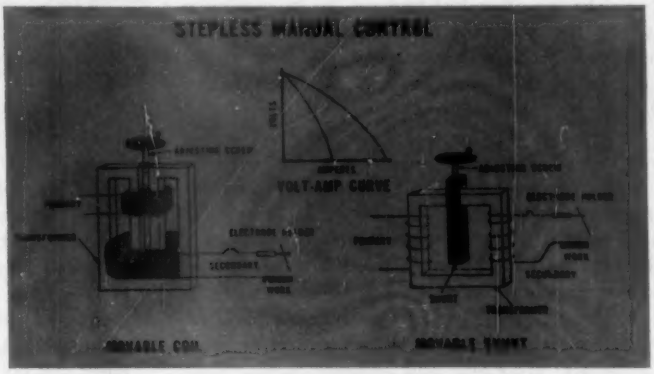
The amperage varies to maintain the proper voltage and with constant voltage high short circuit current is produced. This current type is desirable for some kinds of Mig welding. Slope control on CP machines permits obtaining volt-ampere curves between drooping and constant voltage curves.

● **Rising arc voltage.** An increase in amperage provides higher welding voltage. The amount of rise can be adjustable (slope control). These RAV power sources have very high short circuit currents. The open circuit voltage is generally lower than the arc voltage and can cause arc starting difficulty if the proper equipment is not available to provide a hot start.

On applications necessitating both a-c and d-c, power sources that provide both are available; current, as well as d-c polarity, is changed by a lever or switch.

Other welder characteristics often encountered are hot and cold starting, crater filling at the end of a bead and arc control.

Soft start — a relay permits momentary low starting current. This open relay allows a minimum amount of d-c to reach the saturable reactor; after a fraction of a second, the relay closes and normal welding is possible. This control is used on thin material where burn-through is a problem.



Hot start — a surge of high current is produced at the start which is quickly reduced to the set current. Condensers charge when the machine idles and discharge when the arc is struck, but do not recharge while welding. This is used where deep penetration is desired at the start of welding, for fast starts and to discourage electrode sticking.

Crater fill — the presence of a crater at the end of a bead is sometimes undesirable from an appearance standpoint as well as because blow holes or cracks may be present in the crater. Using a switch or foot pedal, current can be reduced at the weld bead end which decreases the size of the molten pool.

Arc control — provides a change from normal welding to either a digging forceful arc or for unusually low currents. The digging arc enables high deposition rates at "low" amperes and minimizes burn-through. When bridging gaps on sheet metal, a lower than normal current and a short arc are desired. At normal amps the arc digging produces deep penetration.

2—*Electrical characteristics.* Actual open circuit voltage and amps, kw and kva, and power factor with the machine idling are checked and/or calculated. When using the load bank instead of actual welding, the wave form produced was photographed; welder efficiency, power factor, input kva, line current and amps were determined at 33, 67 and 100% of rated output current by recording meters and calculations.

3—*Heat characteristics.*

a. Temperature rise of the primary winding of the main transformer was determined by checking the resistance to current flow at room temperature and after one hour of resistance at rated output. Temperature rise was determined by calculation.

b. Thermocouples allowed determination of temperature rise of the transformer windings, transformer core, reactor windings and the rectifier on the d-c welders.

c. Heat removal from the welder by cooling air was determined from figures obtained by measuring air velocity, calculating the inlet or outlet area and checking the temperature rise of the exhaust air.

4—*Physical characteristics.* Each welder was weighed and measured; fan motor data was recorded; insulation class of the transformer windings were determined; controls, switches, meters and outlet receptacles were listed and other notable features, either good or bad, were recorded.

5—*Circuit description.* Safety devices in each welder were listed, and presence and number of circuit breakers, fuses, resistors, capacitors and relays were recorded.

6—*Welder evaluation.* A point system based on a possible 100 was set up to enable welder comparisons. Electrical performance both idling and loaded were rated. Actual welding ability was briefly observed and tentatively rated. Maintenance or durability (ruggedness, insulation, heat level, circuit protection, etc.) were also rated on a point system.

Final evaluation was obtained by totalling the electrical, welding and maintenance ratings.

Since welding ability is of prime importance, more points were allotted it than for maintenance. Electrical performance is felt to be of least importance compared to the other two features, so its maximum rating was the lowest of the three.

Thus, welder ratings, initial cost, welding ability and durability in production will influence future purchasing of power sources.

Even though Caterpillar investigates welder design and types, welding results and maintenance are still the prime considerations.

The deposited welds must be capable of withstanding the high loads and comparatively low number of cycles for fabricating earthmoving equipment.

In the future, trends will be away from hand or open-arc welding and toward semiautomatic and fully automatic processes. And accurate current controls and stable currents are needed for the newer processes.

Amp and volt meters are desirable, but since they can be easily damaged, protective coatings would be helpful. Test jacks could be used to check the amps with a portable ammeter.

Automatic welding uses higher amps than hand welding and requires a 100% duty cycle rather than the usual 60% one. It also can effectively use higher voltage, which along with the high amps, increases the deposition rates and welding speeds.

At present, remote control is seldom used at Caterpillar. And a great demand for it seems unlikely — although it could be advantageous under certain conditions.

Ease of connection to power lines, auxiliary outlets for powering semiautomatic units, accurate and rapid current adjustment, and machine durability appear important for present and future welding power sources.

Poor machine-construction features usually include: protruding leads; rectifiers very near air-inlets and so positioned that they could be damaged in rough handling; and machines with very large physical size but with very little space occupied by welder components.

Within recent years, one manufacturer of power sources removed the overtemperature protection from the transformer cores on a new model. The machines were severely damaged from overheating because the cooling fans failed.

Outmoded drooping voltage generators have been converted to the constant arc voltage type. To convert a drooping rotating-type generator to produce CAV welding current, all that is needed is a resistor, contactor, transformer and some wiring changes.

Such conversion would permit using present equipment for processes requiring the CAV-type current. A sacrifice in deposition rates of up to 10% will often occur, but in many cases this is not wholly significant.

(In such a conversion at Caterpillar, the CO_2 welding wave forms of the reworked generator look similar to those produced by the original equipment; however more spatter is produced with a resultant decrease in deposition as noted above.)

Conversely, several of the CAV-type power sources on the market can be converted to provide the drooping voltage characteristics.

New processes now on the market, or about to be released, require a special type power source. If a change to the new process is indicated, large capital expenditures will result:

¶ The emissive wire is recommended for use with an extreme drooper d-c power source.

¶ Carbon dioxide welding requires a constant or a rising arc voltage.

¶ Tig welding is best performed using special a-c machines with superimposed high frequency and/or balanced wave.

There are other processes requiring special equipment and power sources which decrease the interchangeability of equipment and necessitate more time, labor and equipment for using and maintaining modern welding methods.

However, there has been a trend toward development of a more universal power source. Direct current machines are available which permit either RAV or CAV, have crater filling, meters, normal or high starting voltage, remote control equipment, built-in primary contactor, off-on switch, a-c receptacles, adjustable arc length and easy paralleling.

Such a unit would be extremely advantageous for a diversified product output, job shop or for research work. However, for large manufacturing operations where one machine can be used for one process or application, the additional cost of a unit having many adjustments and extras would not be economically wise at the present time.

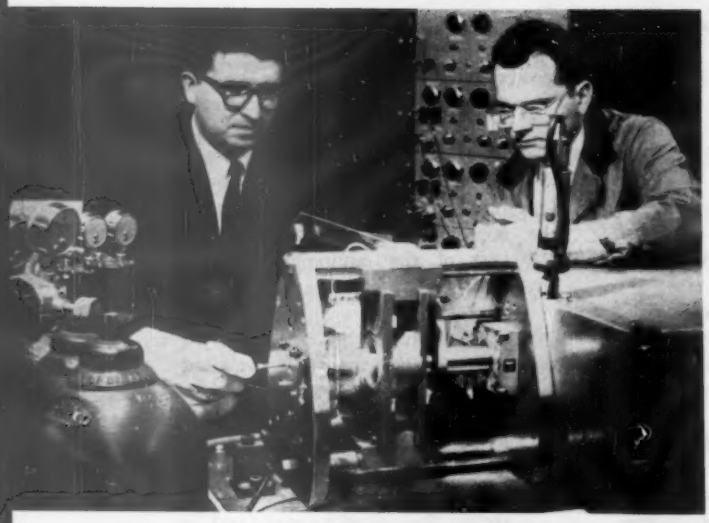
Nevertheless, industry may be driven to this to prevent equipment obsolescence.

In summary, then, generators are available for a-c, d-c or a-c/d-c output. D-c generators may have either drooping, constant or rising arc voltage characteristics. Transformer type a-c welders are provided for hand, submerged-arc, high-frequency and balanced wave welding.

Transformer type d-c units provide high frequency, drooping CAV-RAV or adjustable slopes. The a-c/d-c units appear best suited for hand and submerged-arc semiautomatic welding applications and less adaptable for the comparatively new Mig welding methods.

The applications of welding processes in recent years have taken tremendous strides, and the new processes now being explored indicate that welding will have an even larger influence on future manufacturing.

This article is based on a talk presented at the First Biennial Short Course on Welding Engineering conducted Dec. 5-8 at the University of Illinois.



HIGHLY INSTRUMENTED laboratory friction welder is used by AMF engineers to weld high carbon steel in the first intensive American study of friction welding.

American laboratory studies practical friction welding . . .

PRACTICAL FRICTION welding may be a step closer because of the first intensive American laboratory study of the process.

Evidence that a layer of fluid metal is formed at the interface of metals being friction welded was one of several discoveries made recently by American Machine & Foundry Co.'s Central Research Laboratory in Stamford, Conn.

This evidence, not previously revealed in the few papers written on friction welding, adds to the growing knowledge of the process which has been under intense study abroad since 1957 when V. I. Vill of Russia published a work in the the subject.

The concept of friction welding is not new — some patents based on it date back before 1900 — but there has been little scientific study or understanding of it until recent years.

Friction welding is a process for converting the mechanical energy of two metal, plastic or ceramic objects into thermal energy. This is accomplished by sliding or revolving the objects in contact with each other. Under proper conditions and controls, this friction action results in the welding of the objects at the place of contact.

Friction welding presents a number of advantages:

1—No special preparation of joint faces is required because friction wearing removes irregularities from the surfaces leaving chemically clean, smooth surfaces heated to welding temperature.

2—No direct electrical power is needed.

3—Good quality welds free from oxidation are produced.

4—Welding times are comparable, but specific power consumption is lower than with other butt welding processes.

Many papers and summaries have been published since 1957 in Russian, Polish and Czechoslovakian journals classifying friction welding as a variation of pressure welding. These publications generally state that the weld is made during plastic deformation of the abutting surfaces.

According to this theory, the two objects revolve or oscillate against each other until friction heat produces required pressure welding temperatures; motion is then stopped and the two pieces are held together to form a weld.

A refined explanation from the AMF laboratory states that a layer of fluid metal is formed at the interface of the two objects. This layer acts as a hydrodynamic thrust bearing or pressure lubricant.

Evidence of the existence of this fluid metal, according to AMF reports, occurs simultaneously with high quality welds in alloy steels and certain other metals.

In other phases of the study, the laboratory investigated, derived and measured basic parameters and machine requirements for friction welding. These investigation areas included: speeds of rotation; machine rigidity; time and weld cycle sequence; torque; pressure; temperature; heat treatment, grain growth, metallurgy; and weld geometry.

Using its laboratory machine, AMF also investigated friction welding of a variety of materials including carbon, alloy and stainless steels, brass, aluminum, copper and zirconium.

. . . and so do the Russians

REPORTS FROM RUSSIA state that friction welding is now being used to join tubes up to 150 mm in diameter, according to "Welding and Metal Fabrication."

One Russian report gives an example of friction welding pipe 146 mm diameter by 9 mm thick. According to the report, the pipe was rotated by a 55 kw motor at 600-700 rpm with upsetting pressure applied in stages.

The British magazine also states that as far back as 1957 Russia reported "encouraging results" in friction welding high speed tool tips to carbon steel shanks.

The main Russian application of friction welding is for butt welding circular bar. However, the Russians have done additional work on friction welding thick-walled tubing.

Other possible applications which have been mentioned by the Russians are stud welding by friction and friction to build up worn components.

How temperatures are measured

by E. Kimmel
Director, Research and Development
Tempil Corp.

THROUGH EVERYDAY experience, most of us have acquired a concept of temperature which is adequate for our needs.

However, the term temperature is used loosely and occasionally is interchanged with the word heat, whereas the two terms, when properly used, describe two separate and entirely different concepts.

Heat is a form of energy which can be added to, or removed from, a substance to raise or lower its total energy content. Temperature is the index of this energy's intensity.

Using the degree as the unit of difference, the scales of temperature measurement now commonly employed use two fixed values as reference numbers — the melting point of ice and the boiling point of pure water at standard pressure.

The size of a degree and the number of degrees assigned to a specific temperature depend on the arbitrary values chosen as reference points (*see box*).

Thus, a rise in temperature of a body is associated with the transfer of heat energy to that body.

Observable effects commonly accompanying this phenomenon are:

1—A dimensional increase or expansion;

2—An increase of pressure in a closed system;

3—An increase in the electromotive force (emf) of a responsive circuit;

4—A change in the electrical conductivity;

5—Increased intensity of emitted radiation;

6—Decrease in peak wave length of emitted radiation;

7—Changes of color due to chemical reaction or molecular rearrangement;

8—Changes in physical state;

9—Changes in other physical properties, such as hardness, elasticity, crystal structure, etc.

Any of the foregoing effects can be measured and related to corresponding temperatures on some agreed scale. The following will show how these effects are used for measuring temperatures, or in some cases, for determining maximum attained temperature levels.

The liquid-in-glass thermometer indicates variations in temperatures by making use of liquid expansion in uniformly bored tubes. The most commonly used liquids are mercury and alcohol. The mercury-filled glass thermometer is limited, of course, by the softening point of the glass and the boiling point of mercury.

The gas thermometer uses the expansion of a gas held at constant pressure to measure temperatures.

Because gases exhibit a much greater volume increase than liquids for a given rise in temperature, gas thermometers using hydrogen, helium and in some cases, nitrogen, have been useful in calibration work as a primary standard.

However, the complexity of the apparatus, the size of the gas bulb required and the necessity for making the bulb from costly alloys for high temperatures, limit the use of gas thermometers to research.

Thermoelectric pyrometers make use of the contact electromotive force that exists at the junction of two dissimilar metals, plus or minus the emf due to temperature gradient along the thermocouple wire.

The resulting electromotive force can be measured by a galvanometer or with greater precision, by a potentiometer, and interpreted as degrees-temperature.

Resistance thermometers are a very accurate means of measuring temperatures, and thus are valuable tools. However, the fragility, complexity and comparatively high cost of the equipment involved limit widespread use.

Total and partial radiation pyrometers utilize the known relationship between the intensity of radiation given off by a hot body and its temperature. Industrial instruments are generally partial radiation types since the need for protecting their sensitive parts and for focusing the rays necessitates at least a lens which will absorb part of the radiant energy received.

The amount of radiant energy depends on the distance from the hot object and the emissivity of the surface sighted upon.

Absorption of radiation by intervening smoke and furnace gases lowers the instrument reading and reflection of light from bright surfaces into the instrument raises it. So, in practice, an empirical calibration is made for each specific installation.

The various forms of the optical pyrometer depend on a visual comparison of brightness (energy per unit area) which is independent of distance. Otherwise their characteristics are similar to those of the radiation pyrometers.

The color of a hot body is a function of its temperature and is fairly independent of emissivity. Everyone who deals with high temperatures has used the color of a glowing workpiece as an indication of temperature.

Some work has been done along these lines, but so far instruments based on this principle have not found wide application, although from a theoretical point of view, this is an attractive possibility.

Many chemical compounds undergo molecular rearrangement or decomposition at elevated temperatures. Some of these transformations are accompanied by a marked color change which may be used as an indication of an at-

tained-temperature level.

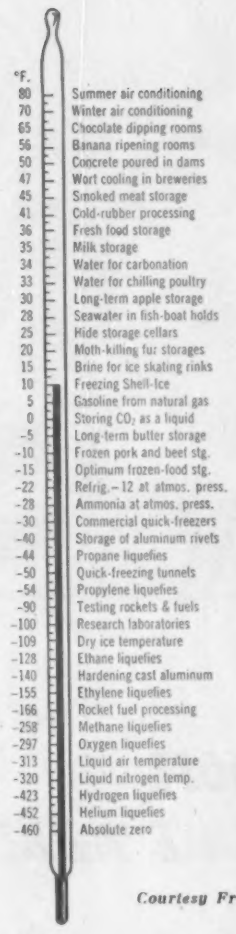
A number of the more dramatic color changing mechanisms are incorporated into different temperature sensitive paints. Some of these show a single color change at a predetermined temperature level.

Most of the paints, however, exhibit several successive color transformations as the temperature increases. These color changes are time-dependent in that the duration of heating will determine to some degree the temperature at which they occur. Nevertheless, they provide a useful means of investigating temperature distribution in many applications.

These heat-sensitive paints are intended for monitoring the safe upper temperature limits of industrial processes, such as the operation of electrical transformers, steel mixing tanks, etc. Some of the types available commercially have good weathering properties and good adhesion at high temperatures.

For measuring surface temperatures, chemical signals are now available that can be deposited directly on surfaces where temperatures are to be measured. These are temperature-indicating crayons, liquids and pellets.

The crayon and liquid forms are available in 81 temperature ratings ranging from 100 to 2,500 F in regularly spaced temperature intervals; temperature range for the pellets is from 100 to 2,750 F in 92 systematically spaced steps. Their accuracy of plus or minus 1% of the stated temperature rating is usually adequate for the majority of industrial applications.



Courtesy Frick Co.

When using the crayon, the workpiece is stroked with the proper temperature-indicating crayon from time to time during the heating process. If the surface is below the temperature rating of the crayon, a dry mark is left. When the stated temperature is reached or exceeded, the crayon leaves a liquid smear.

If the heating cycle is of short duration, it is sufficient to make a mark on the workpiece with the proper crayon before heating begins. When the workpiece reaches the stated temperature, the mark liquifies and on subsequent cooling will solidify as a translucent smear which is readily distinguished from the original mark.

Temperature-indicating lacquer consists of materials very similar to those of the crayons, but are suspended in an inert volatile nonflammable liquid. It is especially useful for application to smooth surfaces such as glass, plastics or polished metals.

Applied to the workpiece by dipping, spraying or brushing, it dries quickly to a dull, opaque coating. When heated, the dried lacquer melts as soon as its temperature rating is reached. When it cools, it solidifies with a characteristic glossy crystalline or transparent appearance.

Unlike the crayons, the lacquer cannot be deposited on a surface which is already hot, but must be applied before heating begins.

Temperature-indicating pellets are intended for use in connection with heating of large units, heat-treating operations inside a furnace, and in general, where observation must be made at some distance.

The pellets must be placed on the workpiece before heating begins. After melting at its stated temperature rating, the liquid residue will survive a long period of heating. Pellets provide an excellent attained-temperature signal suitable for later examination.

The four temperature scales

On the Fahrenheit scale, named after German Scientist Gabriel Fahrenheit, the melting point of ice is fixed at 32 degrees; the boiling point of water at 212.

Anders Celsius, a Swedish astronomer, proposed the temperature scale called centigrade, centesimal or Celsius, which defines zero as the melting point of ice and 100 as the boiling point of water.

William Thomson, later Lord Kelvin, proposed a thermodynamic temperature scale. On this scale the interval between the temperature of melting ice and boiling water is given as 100, so the Kelvin degree, for practical purposes, is the same size as a Celsius degree.

The ice point is usually 273.16 on the Kelvin scale, so temperature readings are 273.16 more than the corresponding Celsius values.

The Rankine temperature scale, named after the Scottish engineer, is essentially the same as the Kelvin scale except that its degree equals in size that of the Fahrenheit scale.

Formulas for converting the four scales are: $C = 5/9\ (F-32)$; $F = 9/5\ C + 32$; $K = C + 273.16$; and $R = 9/5\ K$.

by Harold Bach
Chief Welding Engineer
National Electric Welding Machines Company

Eight steps

1. Participate in design
2. Provide adequate power, water and air
3. Insure proper installation
4. Provide trained personnel
5. Maintain a log
6. Provide proper maintenance
7. Keep spare parts on hand
8. Maintain the electrodes

HOW TO GET THE MOST FROM YOUR RESISTANCE WELDER

WHO IS AT FAULT when a resistance welder refuses to weld?

When his spot welder wouldn't work, one customer immediately blamed the manufacturer who quickly sent a man to check the machine from top to foundation studs.

Everything was in order – everything but one electrode which had been sealed tightly in pipe compound. Pipe compound may be right for a punch press, but it has no place in a resistance welder. The maintenance man couldn't have found a better insulator.

The welder performed perfectly when the electrode was replaced and the compound removed. Machine production, however, had already been halted for 2½ days.

Rush service calls of this kind are not rare for resistance welder manufacturers. Each year hundreds of hours and thousands of dollars are lost due to malfunction and breakdown through no inherent shortcoming of the welder.

Most malfunction complaints originating in the plant do not come from plants operating a number of welders, but from those operating only one or two.

One reason for this is that larger plants frequently have their own welding engineer or a separate welding department responsible for supervising maintenance and operation, and for establishing machine settings and job set-up.

In plants where there are not enough welders to justify separate departments, set-up, operation and maintenance are often assigned to personnel who may be having their first experience with resistance welding.

Getting the most out of a resistance welder is largely a matter of having a clear understanding of the equipment, following instructions, and using common sense.

In spite of the many factors governing performance efficiency, there are eight basic rules which can help provide maximum trouble-free performance from resistance welders.

These eight rules are:

1—Participate in design. Users often shirk this responsibility. Later trouble can be headed off by giving the original equipment manufacturer a clear picture of what the machine is expected to do. Often, in his zeal to stretch capital cost dollars, a user tends to over-project a machine's use. Unless the builder is given some idea of what the machine will be doing and the welding pressures involved, he can not intelligently design a machine with proper capabilities.

2—Provide adequate power, water and air. Investigate the power supply if there is any possibility the welder may overload the main power source. This is particularly important in plants located in outlying areas served by local generating stations. The voltage drop

should never exceed 10% when the welder is operating at maximum capacity.

The water supply should not only be adequate, but must have the proper chemical makeup and temperature. Unfiltered water can plug a transformer or clog cooling lines.

Welders are sensitive to climatic and atmospheric conditions, and extremes in temperature affect tubes and electronic controls. In addition metallic dust and a change in oil viscosity in the hydraulic system because of plant temperature can be critical.

3—Insure proper installation. A welding machine weighing up to several tons requires proper footings and solid anchoring. The biggest source of later trouble is "hurry-up" installation. Failure to conform to local electrical codes, jury rig connections and minor items, e.g., strainers left off the water system, can cause costly shut-downs.

4—Provide trained personnel. The manufacturer normally sends a serviceman to supervise installation. This serviceman establishes set-up charts, explains maintenance and operating procedures and puts the welder in production. When the serviceman leaves, trial-and-error operation, which can be costly, comes into effect if plant personnel do not follow procedures recommended by the manufacturer or authorities, such as the Resistance Welder Manufacturers' Association.

For example, an uninformed operator who is not getting a weld may turn up the pressure — a move which decreases welding heat. He then turns up the heat and finds himself in a vicious cycle ending in mushrooming electrodes, damage to transformer and electronic controls and eventual breakdown.

5—Maintain a log. By making a record of welding pressures, material characteristics, transformer tap settings and such set-up specifications as squeeze, heat, hold and off cycles, the operator has ready reference for maintenance or for location of trouble spots. Manufacturers of electronic controls used on welders often provide suggested forms. Simple logs can also be prepared in the shop. (See sample below).

6—Provide proper maintenance. The general maintenance man, shop electrician or general hydraulics man can save thousands of dollars by reading and following the manufacturer's recommendations for maintenance or by consulting RWMA Bulletin No. 14, a general maintenance manual for resistance welding machines.

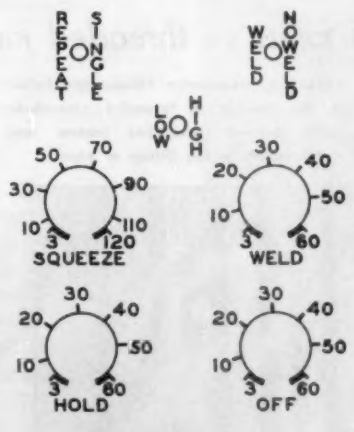
7—Keep spare parts on hand. A day of production can be lost when a $6 coil or $3 tube could have placed the welder back in operation in minutes.

8—Maintain the electrodes. In the final analysis, good weld quality depends on properly maintained electrodes. Copper-alloy electrodes and dies should never be attacked with files, pipe wrenches or ball-peen hammers. Again manufacturer's recommendations and RWMA Bulletin No. 14 are valuable guides.

Welding performance log

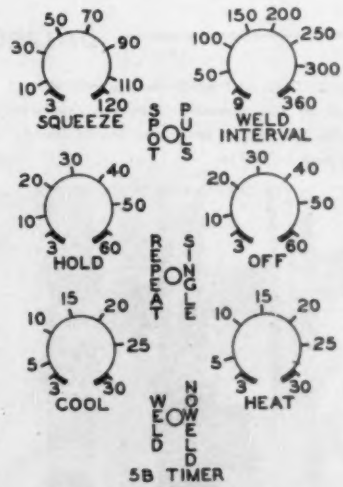
DATE: .....
PART NO. .....
PART DESCRIPTION: .....
.....
MATERIAL: .....
Thickness: .....
Type: .....
Coating: .....
PHASE SHIFT (%): .....
PRIMARY CURRENT READING: .....
SPOT PRODUCTION: .....
Spots — 10 seconds: .....
Spots — minute: .....
REMARKS: .....
.....
.....
.....
.....
.....
.....
.....
.....
.....
Signed: .....

WELD PRESSURE: .....
GAGE PRESSURE: .....
ELECTRODE UPPER:
Shape or contour: .....
Material: .....



3B TIMER

ELECTRODE LOWER:
Shape or contour: .....
Material: .....
WELDING MACHINE NO. .....
TRANSFORMER TAP: .....



5B TIMER

OPERATOR BRAZES hot and cold water branch supply lines at the Beckman-Downtown Hospital in New York City. Lines shown are copper, 2 in. down to ½ in.

- Weight saving
- Precise length
- Easier fit-up
- Joint certainty
- Less waste

Why you should braze small diameter piping

by Alden W. Swift
Handy & Harman

BRAZED JOINTS are rapidly replacing threaded joints in commercial plumbing — and for good reasons.

Silver brazing offers advantages in both service and installation since:

(1) A properly made joint is, for all practical purposes, failure-proof and (2) brazing saves time, effort and material on the job.

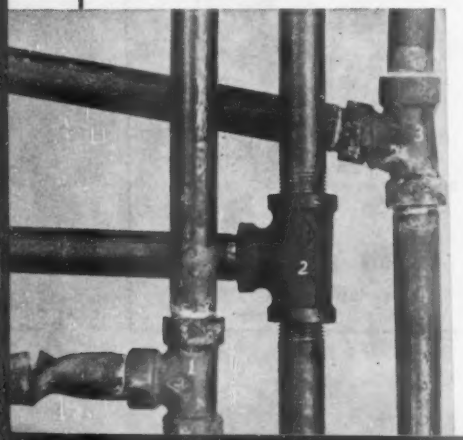
A number of extensive studies have been conducted by independent and publicity-supported laboratories to evaluate the relative strengths of brazed and threaded joints. Most of these tests were intended to determine how well the two types of joints would stand up when the test specimens were stressed to the point of failure.

A series of tests, made available by Stanley G. Flagg & Co., Inc., show that with brazed specimens, failure occurs in either the pipe or fittings, never in the joint, and with the threaded specimens, failure always occurred at the threads. Thus, the strongest point in a brazed piping assembly is the joint and the weakest point in a threaded assembly is the threads.

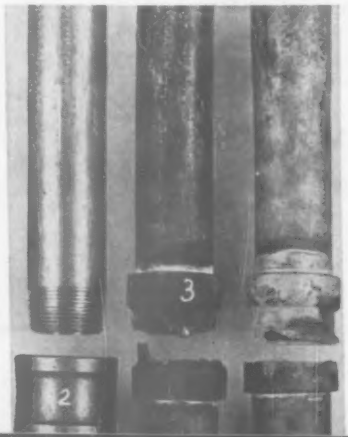
These tests involved a variety of brazed and threaded piping put through tensile tests, torque tests,

Brazed joints vs. threaded joints . . .

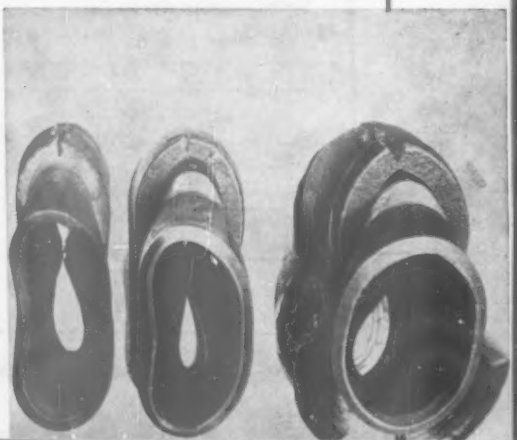
TWISTED to destruction the threads stripped in the threaded specimen (center) while the brazed specimens shown failed in pipe or fitting.



PULLED to destruction 1½-in. pipe failed in the threads in threaded assemblies (left). Brazed assemblies (center and right) failed in the fitting or pipe.



CRUSHED 90 deg elbows containing 2-in. nipples of 1½-in. diameter showed that brazed joint (left) survived while threaded joints (center and right) gave way.



compression bending tests, crush tests and vibration tests. In every case, the brazed joint proved to be the strong point.

The tests were largely concerned with the effects of stress applied during a relatively short period. In practice, joints are seldom subjected to sudden, large forces. Usually they are subjected to steady stress of a lower order or to a repeated, but rather gradual, build-up and relaxation of the stress.

A typical condition of this stress is cyclic expansion and contraction of hot water systems. Piping expands as hot water enters a cool line, and then contracts as the line cools off again.

This action tends to push and pull the pipe in and out of the fitting, particularly where the pipe line is rigidly mounted or changes direction, so the entire line cannot move as a unit. In the case of threaded joints, the push-pull cycle wears down the threads, so that in 1 to 5 years, depending on the severity of the action, the joints will develop leaks and require maintenance or replacement.

An outstanding attribute of a silver brazed joint is its ability to resist this creep or tendency for the pipe to ride out of the fitting because of steady or repetitive pull.

Thus, a soft-solder joint may have a shear strength of 4,000-5,000 psi at room temperature, but at 250 F this reduces to 80-325 psi depending on the composition. At this upper temperature, a silver brazed joint will maintain a shear strength of 20,000 psi and at room temperature the strength rises to 40,000 psi. These conditions are well beyond the strength requirements of the usual system, but they demonstrate why silved brazed joints give dependable service at temperatures of -450 to +450 F and at pressures of 3,500 psi with heavy-duty fittings and up to 6,000 psi with special fittings.

Another advantage of a brazed fitting is that the IDs of the fitting and the pipe or tube are nearly the same. This straight-through flow eliminates the turbulence normally experienced around the inlets and outlets of standard threaded fittings.

In addition to these service advantages, brazed piping offers five definite installation advantages:

● **Weight saving.** Since brazed piping requires no threading, thin-walled pipe, usually tubing, is used. In addition, brazed fittings are about 30% lighter than comparable fittings.

● **Precise length between fittings.** Pipe runs between brazing fittings can be cut to exact length with no guesswork to allow for threading. The proper length is the distance between the fitting faces plus the depth of the cups which is standard for each size fitting. This eliminates the need to overtighten or slacken the joint to adjust for small variations in pipe length, which may damage the threads or leave too few threads engaged for a sound joint.

● **Easier fit-up.** Because threadless fittings can be swiveled freely during fit-up, the lines can be assembled and aligned easily and quickly. In addition,

A glossary of useful brazing terms

Alloy — See "silver-brazing alloy."

Base of the cup — The deep end of the cup near the shoulder. This part of a fitting is heated by directing a torch flame at the outside around the same general region as the interior cup shoulder.

Bore — The inside diameter of the cup on a fitting.

Brazing alloy — See "silver-brazing alloy."

Capillary action — Flow a liquid when it is drawn into a small space between wet surfaces. In brazing, the liquid is molten silver-brazing alloy.

Cup — The accurately machined bore in a brazing fitting into which the pipe fits.

Face-fed or feed-in — Describes the type of fitting which has no built-in supply of silver-brazing alloy. The necessary alloy is fed in from a strip or rod during the brazing operation.

Flexible extension — A length of soft copper tubing with fittings that adapt it for use with an oxyacetylene torch tip; employed to position the tip as desired in close quarters.

Fillet — The small bead of alloy in the chamfer at the cup edge when a brazed joint is complete.

Flux — The preparation applied to metal surfaces for keeping them free of oxides during heating and during brazing.

Gap — The space between the outside of the pipe and the inside of the cup. (If both are perfectly round, the gap will be one-half the difference in diameters.) For lap seams and other types of joints, the gap is the clearance space to be filled with alloy.

Insert — A ring of silver-brazing alloy set into a machined groove in the cup of a fitting.

Oxide — The scale that forms on metal surfaces when they are exposed to air and especially when heated.

Oxidize — Of a metal; to combine chemically with oxygen, forming another composition which is called an oxide.

Preinserted-ring type — Describes the kind of fittings that have inserts to supply silver-brazing alloy to their joints.

Reducing flame — An acetylene flame that has some extra gas in the mixture (contrasted with an oxidizing flame which has extra oxygen in the mix).

Shoulder — The machined ridge at the bottom or inner end of the cup, where the pipe end seats.

Silver-brazing alloy — Metal that contains silver in its composition, and which is designed especially for relatively low-temperature joining of metal parts such as pipe, tubing and fittings.

Courtesy: Stanley G. Flagg & Co., Inc.

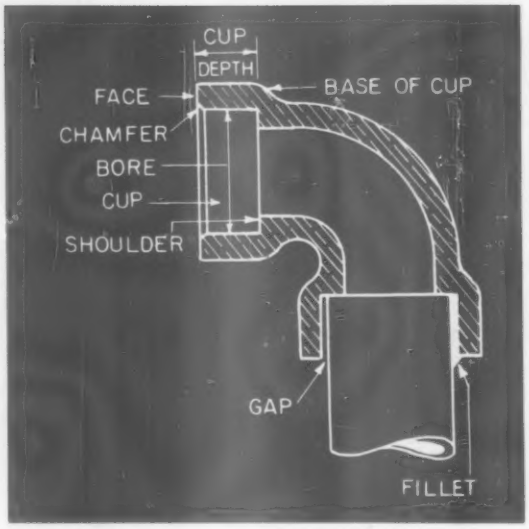
joints can be made by brazing in narrow quarters and close clearances where it would be awkward or impossible to insert a pipe wrench.

● **Better certainty of a good joint.** A trained operator can usually tell at a glance if he has made a good brazed joint. If he has properly fluxed and heated the assembly and flowed enough alloy into the joint, he will see a continuous fillet of alloy at the chamber of the fitting, which indicates a solid joint. There is no comparable advance indication for a sound threaded joint.

The fitting and pipe are partially annealed during brazing which adds to the certainty of a good joint by giving the metal some additional ductility and making it better able to withstand sudden shock and pressure surges without splitting.

● **Less waste.** If a brazed joint leaks, it can be repaired by reheating and flowing in a little more alloy, or at worst, taking the joint apart, cleaning the fitting and pipe and brazing them back together. If a leak occurs in a damaged thread, usually the whole run of pipe must be scrapped and a new piece cut, threaded and installed.

Considerable interest in silver brazing has been shown by a number of plumbers' local unions. For example, Plumbers' Local Union No. 1 of Brooklyn and Queens, with a registered membership of 2,200, has inaugurated a 20-hour evening course to train interested journeymen plumbers in silver brazing techniques.



SOME definitions for brazing pipe fittings. (See glossary, p. 45)

According to the director of training education, the response by union members has been exceptional. Of the 1,500 members who received the announcement of the course, more than 700 returned registration cards. Moreover, the class has a completion rate of better than 90%.

Trouble shooter's brazing check list

Difficulty	Cause	Correction
alloy balls up, won't flow	joint too cool; or dirty or oxidized surface	continued heating; if joint dirty start over — clean metal with emery, flux and rebraze
alloy wets both surfaces but won't flow into joint	too much clearance	use alloy with nickel content for better bridging of gap
bare spots in flux coating	surface greasy	degrease with solvent before brazing
alloy spreads too quickly	surface too hot	let surface cool slightly before continuing
in hand feeding, alloy flows in wrong direction	pipe too hot and/or fitting too cool	apply flame to base of cup to draw alloy inwards
clearance opens too wide during heating	too much heat on fitting and/or too little on pipe	heat the cooler part to obtain balanced temperature
pipe bows out during heating	pipe can't expand freely, motion restricted at both ends	relieve restriction at one point; pipe should be freely supported, not clamped
pipe sags or is misaligned in fitting	weight on pipe or insufficient support during brazing	place supports to keep pipe aligned in fitting; keep weight off pipe
flux caked, hard to remove	flux cooled off before removal attempted	apply wet rag or swab while flux still hot; flux will crack off easily

What is the welding inspector's job?

by **Bela Ronay**

WHAT ARE THE WELDING inspector's duties and what is the scope of his authority and decision making judgment?

To answer this question, an inspection department should differentiate between matters concerning engineers only and those the inspector is qualified to handle.

Inspection actually starts with checking the mechanical properties and chemical composition of the material procured for the project by the contractor. Such inspection is the duty of the engineer and should not concern the inspector.

Then comes the procedure qualification test. This is the opportunity for the inspection department to train and instruct the inspectors assigned to monitor the job.

In the course of witnessing and recording the procedure qualification test, the supervisor should:

1—Learn whether the inspectors are familiar with the process demonstrated including peculiarities of the welding equipment and critical details of applied procedure. If weaknesses in inspection knowledge are noted, the supervisor should instruct the inspector and provide material necessary to develop required competence.

2—Use the data recorded during the testing to make a check-off list to serve as a permanent guide for field personnel. The list should include items to be monitored, the tolerance of each item, notations as to whether the inspector has the authority to halt production in case of non-compliance with the test data, and specific information on the types of defects for which the field inspector should immediately contact his supervisor.

The next step is evaluating the performance of the inspector. This means personal contact between supervisor and field personnel on occasions when the most critical fabrication is underway.

This is the time for the supervisor to give needed instruction and eliminate those who are not sufficiently qualified as inspectors. A few such visits bring about mutual understanding and respect between the supervisor and his crew. Such understanding benefits both producer and purchaser.

Trained inspectors should then be able to catch irregularities as they begin to appear. By drawing the irregularities to the attention of the production official, inspectors can prevent major defects from developing and save fabrication time while assuming weldments free from repair and in the condition specified by the designers.

In many respects, the inspector's duties are clear cut. In the course of production, there may be several mechanical tests of the Go/No Go variety. For procedures controlled by such tests, the inspector should have full authority to act and suspend operation when specimens fail to pass the test.

At times, inspectors may find engineering conditions which they deem harmful to the procedure although they lack documentation for their findings. In such cases they should report to their supervisors orally as soon as they feel justified in their belief and, at the close of the day, they should put their findings in writing as part of their daily report. Such records may be quite valuable if the case becomes a matter of litigation.

The following specific examples represent some commonly occuring controversial irregularities facing the inspector:

1—Intermittent heavy loads cutting into a power line which feeds resistance welders.

2—Heavy intermittent electrical loads on a feeder line of rectifier or transformer welders.

3—Discovery that welding electrodes of a different brand from the one used in the procedure qualification tests are being used in production.

4—Discovery of laminations in flame-cut or machined bevels prepared to form welded joints.

5—Discovery of change of joint design which may occur because of an error in the preparation of the bevel angle or some other reason.

6—Reluctance of fabricator to chip out and repair a weld containing porosity of borderline volume indicated by radiographs in an area where, in his estimation, shrinkage of the repair weld might cause undue distortion of the weldment.

In any of the above cases, depending on the procedure set up, the inspector should either report orally to his supervisor, put his findings in his daily report or halt production immediately.

Another point to remember is that the alert inspector can effectively monitor welding quality by visual examination. He can correct faulty slag removal and deposition of high crowned string beads, and departure from any item in the test. Using a focused beam flashlight, for example, even in daylight he can differentiate between undercutting and lack of fusion at the toes of seal beads and fillets.

There are many other things the inspector should be able to handle. To further assure qualified inspection, supervisors and inspectors should read and become familiar with the AWS Inspection Handbook B1. 1-45.

Army shipments travel in welded steel containers

ALL-WELDED STEEL shipment containers pay off for the U.S. Army.

According to the U. S. Army Transportation Materiel Command, St. Louis, welded CONEX containers save time and reduce loading and handling expenses during transit. In addition, the boxes, first used experimentally in Korea, prevent loss by accident, carelessness and pilferage and, when used for equipment such as radar, they insure components arrive together.

Showing their faith in the boxes, the Army has made them standard equipment and has recently awarded a contract to United Steel Fabricators, Inc., Wooster, Ohio, to produce an additional 6,500 of the welded steel containers. Less than three years ago, the firm produced 4,000 such containers for the Army.

Manufactured in two sizes according to military specifications, each box is made of 9-to-14-gage corrugated steel.

The larger boxes are 6-ft 3-in. high, 6-ft 10½-in. wide and 8-ft 6-in. long. Capacity of each of these boxes is 295 cu ft with a 9,000 lb maximum weight.

The smaller boxes, for airborne shipment, have the same dimensions, but are only 4-ft 3-in. long — exactly half the length of the larger ones. These boxes have a 135-cu-ft and 9,000-lb maximum weight capacity.

Using cold-finished and hot-rolled carbon steel bars and low carbon steel sheets, all container parts are welded in accordance with AWS recommended practices.

Each box is then welded to sleds to permit handling by fork lifts and each has lift rings welded at top corners for crane hooks.

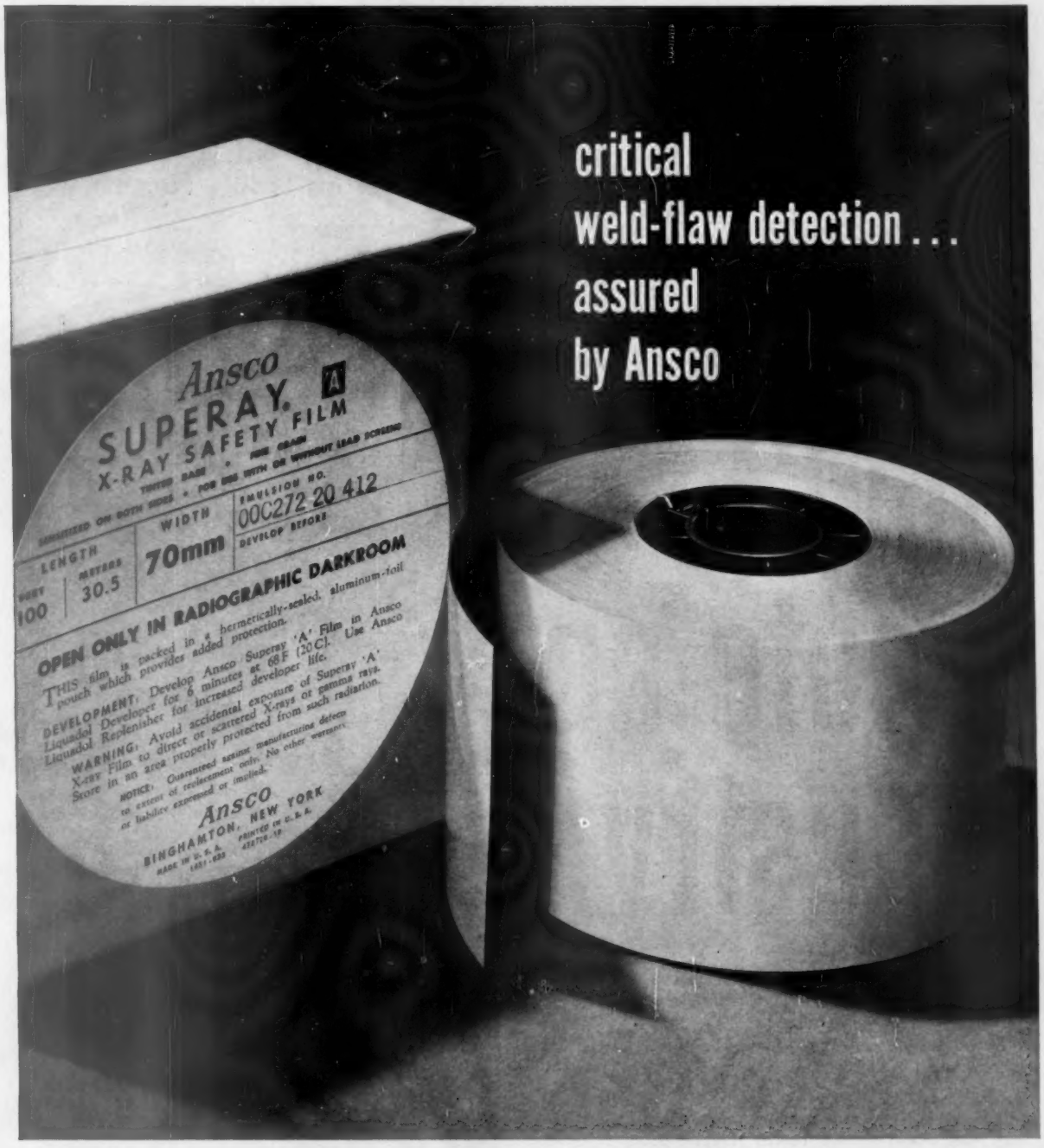
According to official military specifications for minimum weld dimensions, butt-welded joints of the boxes must have 100% penetration, arc-welded seams must have a 1/16-in. bead, and the fused portion of resistance-welded seams must be 3/16-in. wide. Where a seam weld is indicated, it must be a continuous weld extending the entire length of the material joined.

For fillet welded joints, if the thinnest material is 0.050 in. or less, minimum weld size is 1/16-in. wide and maximum weld size is ⅛ in. If the thinnest material is more than 0.050 in. but less than 0.125 in., minimum weld size is ⅛ in. If the thinnest material is 0.125 in. or more, weld size is ¼ in.

All welds must be free from defects such as excessive porosity, overlap, entrapped slag, undercut, nonfusion, burn through, and insufficient penetration (see table).

Classification of defects

Location	Defects and categories		
	Critical	Major	Minor
Lifting lug to corner posts; corner post to sled; corner post to front or rear sill.	Nonfusion, undercut, incomplete penetration, weld undersize, weld missing, weld spacing dimensionally incorrect, weld cracks.	Excessive porosity, entrappd slag, burnthrough.	Overlap.
Sides to sled, floor, or roof; rear panel to roof or rear sill; floor to sled; hinges to door or corner post; stiffener to roof Z and side; floor sheet to corrugations; roof sheet to roof corrugations.		Nonfusion, undercut, incomplete penetration, weld undersize, burnthrough, button undersize, weld missing, weld spacing dimensionally incorrect, weld cracks.	Excessive porosity, entrapped slag, overlap.
Roof corrugation to Z section; door joints; gussets to corner post on door; sled buttress to under-side of floor; sled sill supports to sled; sled bottom to sled sill.		Nonfusion, incomplete penetration, burnthrough, weld missing, weld cracks.	Weld undersize, excessive porosity, entrapped slag, overlap, undercut, weld spacing dimensionally incorrect.
Side and rear panels; door corrugation to channel (seam welds).		Seam not continuous, seam width undersize, weld cracks.	



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How to create an industry

THE ART of electric welding, as it was practiced in pre-World War I days, would completely frustrate today's production planner. Costly, asbestos-covered electrodes had to be used to weld joints that, all too often, were erratic and of sub-standard quality.

THEN AN IDEA from A. O. Smith turned and shaped this temperamental technique into what is today the world's most useful metalworking method. Essentially a simple idea — this development took the vagaries and the high cost out of electric welding. It turned this art into a wide-reaching industry.

THE PICTURE-STORY at right tells how it happened — and how A. O. Smith progress is continuing to make things happen in welding for the future.

Through research ...a better way

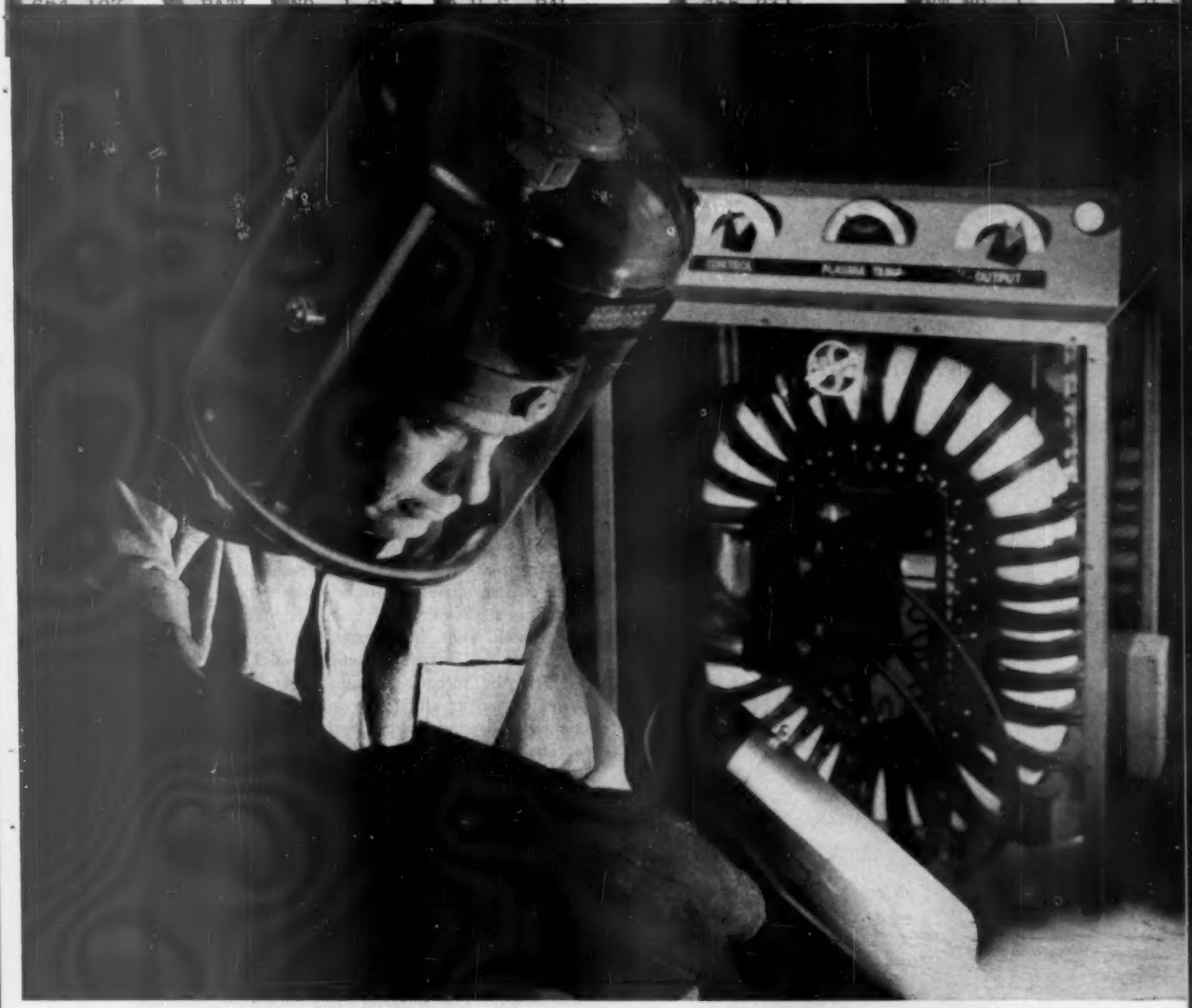
A.O.Smith
CORPORATION

WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin

A. O. Smith INTERNATIONAL S.A.,
Milwaukee 1, Wisconsin, U. S. A.

THE BEGINNING, 1917 — With the world at war, it became impossible for our country to import the asbestos-covered electrodes that were, at that time, considered essential in the welding of aerial bombs. Working furiously in the face of this emergency, A. O. Smith came up with an answer — electrodes wrapped in sodium silicate treated paper. Not only did this solve the immediate problem, but it led to A. O. Smith's invention of the **extruded** electrode which ushered in the modern era of mass-production welding.

THE PROGRESS — Out of A. O. Smith's continued development of a truly practical arc-welding electrode has grown an industry impossible to estimate in cash values. Wide-spanning bridges, tall-reaching buildings and low-contoured cars all reflect this progress, with welded components providing strength where it is needed. And in terms of total technology, A. O. Smith has remained the leader, pioneering such advances as the CO_2 welding process shown above, for stronger, more accurate and more economical work.



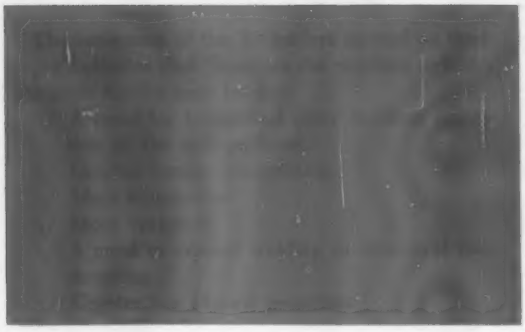
WHAT'S TO COME — NUCLEAR-POWERED WELDING — Already at work on the welding equipment and processes of 25 years from now, the scientists of A. O. Smith have visualized the STELLARWELD. This spectacular power source could conceivably utilize fusion power. With science on the threshold of establishing a self-sustained fusion reaction to produce electrical power, the STELLARWELD becomes a logical next step. This self-contained power source could, it is estimated, easily supply 20,000 kw (sufficient for as many as 2500 arcs), as well as its own reaction current and starting-voltage requirements. The proposed fuel could be deuterium, the heavy isotope of hydrogen found in ordinary water. With the tremendous energy release potential of a fusion reaction, the problem is not one of gaining sufficient capacity, but rather one of scaling down this energy potential to a size more conveniently handled in welding.

This future-thinking creativity is at work throughout the A. O. Smith Corporation, finding the "better way" in scores of products for industry, government, farm and home.

For more facts Circle No. 172 on Reader Service Card

What's ahead in '61

Welding leaders look to the Future



James W. Owens
Welding Engineer
James W. Owens Administrative
& Technical Services

THERE ARE FEW ALIVE TODAY who know that in the decade in which WELDING ENGINEER was courageously launched, welding was practically prohibited on the railroads of our nation by the Interstate Commerce Commission.

The reason for this prohibition was the loss of life and property as the direct result of promoting and using the process by individuals and organizations who lacked the necessary knowledge and skills. Neither were then generally available.

This prohibition, together with the belief of naval architects in general that "the construction of welded ships is impossible," constituted major blocks to welding progress in all fields of its potential application. The reasons given by these architects for this professional stand were that "joint slippage, as occurs in the riveted joint, is a design requirement"; and because of "the human element in welding."

With the foregoing prologue, and the fact that welding and its allied processes are no longer questioned as dependable fabricating processes, I predict:

That the American Welding Society will sponsor and obtain an early revision of both the administrative and technical requirements of qualification tests for weldors in our national codes.

That the pressing social and economic needs of the world's exploding population, the urge of underdeveloped nations to catch up with the more advanced nations, and the keen competition between nations, will produce undreamed production demands on welding and its allied processes.

That to meet these demands and challenges, there will be a need for business and professional personnel with even greater knowledge, courage, imagination and vision than in the past four decades.

That unless the world reverses its present materialistic trend and blends its economic and scientific motivation with the spiritual, this "progress" will be a curse rather than a blessing.

The mild steel sleeve is shown welded around the ripper shank. When badly worn it is easily replaced with a new sleeve.

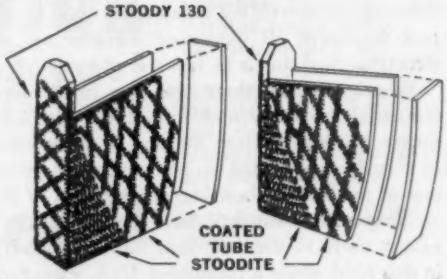
HARD-FACING "Non-Weldable" RIPPER SHANKS

A simple method for hard-facing non-weldable high carbon ripper shanks now extends shank life almost indefinitely! Solution is a fabricated sleeve tightly fitted around the shank to which the hard-facing is applied. Side and back sleeve panels are cut from ½" mild steel plate. The front panel is 1" plow steel. After strength welding sides to front panel, the unit is slipped around the shank and the back panel welded in place.

Front faces of the sleeve and replaceable ripper tooth are protected with Stoody 130—*a semi-automatic wire containing tungsten carbide particles—extremely resistant to abrasion.* Since sleeve sides receive less wear they are adequately protected with Coated Tube Stoodite—*a high-alloy manual electrode.*

Occasional hard-facing touch-ups keep the sleeve in good condition. When further reclamation becomes impossible a new sleeve is easily installed. Thus, little actual wear ever reaches the ripper shank itself. The replaceable tooth is rebuilt and hard-faced, as required.

This is only one of the hundreds of ways to cut maintenance costs and lick downtime with Stoody alloys. For more cost-cutting suggestions, see your Stoody Guide Book—*the original and best guide to equipment maintenance!* Ask your Stoody Dealer (check the "Yellow Pages" of your phone book), or write direct.



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✓ New processes

R. N. Thompson
Editor
Welding and Metal Fabrication
London

THE FUTURE WOULD SEEM to be bright with promise for those engaged in the manufacture of welding equipment and for those engaged in welded fabrication. Taking a chance to predict the shape of things to come, one can well assume a greater increase in fully automatic arc welding and an even greater increase in semi-automatic welding with the continuous wire fed hand gun using one form or other of gas shielding.

The question of the most appropriate shielding gases, or mixture of shielding gases, for different materials, is now being closely studied and is likely to be given increasing prominence. Just how far this semi-automatic hand gun will bite into the manual electrode market is anybody's guess.

Another big query is how far electroslag welding will go in the fabrication of heavy plate weldments and castings. Up to now, very few companies have tried this process in Britain, but there is a lively though cautious interest in the process; electroslag weld quality seems, however, still open to question.

✓ Expansion

R. J. Findlay
Managing Editor
Welding Fabrication and Design
Australia

THE STORY OF AUSTRALIA in the postwar years is one of tremendous expansion (a great upsurge in population due to immigration) accompanied by tremendous pressure on our industries to provide the homes, goods and services these additional people require to attain and maintain the country's high living standards.

It is natural to expect that such expansion should be associated with an efficient and growing welding industry, since welding today plays such an important part in almost all phases of manufacture and construction. And this is in fact the case.

Where recently there was one major supplier of industrial gases, we now find three. The LP gas industry has grown from nothing to lusty adolescence in a matter of months — not years. The promise that one of the world's best known suppliers of resistance welding equipment will have his Australian factory rolling early in the new year has stimulated activity in this field while a prominent U. S. manufacturer of arc welding equipment is just launching his product on the local market.

Competition is becoming keener, for in Australia the rewards will be great.

✓ Deposition rates

R. H. Hoefler
Chief Welding Engineer
Kaighin & Hughes, Inc.

AN INDUSTRY CAN ONLY GROW as rapidly as men are trained to properly apply that industry and translate the results of its application. American colleges can no longer turn their backs on the need for properly conducted welding courses as a phase of undergraduate engineering study.

We of the welding industry cannot demand that our colleges add these courses to their curricula unless we can provide these colleges with properly trained personnel willing to conduct these courses. An improperly trained engineer can do as much, or possibly more, damage to the growth of the welding industry as one with no welding training.

Considerable advancement has been made toward developing processes and electrodes aimed at increasing deposition rates. Standards must be developed so that deposition rates may be realistically compared and applied to the various industries that employ welding.

Welding technology will continue to advance because our industry is aware of its shortcomings, and representatives of the industry are pledged to correct the shortcomings by supporting activities of our welding society. We are aware of the fact that growth is slow unless we share the results of our welding experience with other representatives of the industry.

✓ High-speed welds

Thomas Crawford, Consulting Welding Engineer

LOOKING BACKWARD ONE CANNOT help but feel that we have indeed come a long way. But looking ahead one cannot help feeling humbled, if not chastened, by a recognition of the inevitable future developments of our industry. I wonder how my professional counterpart of the year 2000 will view our "welding science" of today.

As to the foreseeable future, the welding industry cannot help but grow in its entirety. The rate of growth of any particular phase of it will depend largely upon how much basic research, engineering development and imaginative businesslike effort is put forth in that particular area. Good crops stem only from sound seeding. The manner in which fusion welding has moved ahead during the last decade in areas traditionally more commonly associated with resistance welding is indicative of the above.

Technically, if I may venture a prediction, I foresee increasing respect for high-speed low-penetration welds, vastly improved techniques for localizing and controlling heat inputs, and more sophisticated control of pressures. Accompanying all of these will come less operator dependence, more automation, yet greatly facilitated set-up.

✓ Technology

H. E. Schultz
Consulting Engineer
Large Jet Engine Dept., FPD
General Electric Co.

THE RATE OF PROGRESS from the beast of burden to our present position in the conquest of space has been characterized by its decidedly accelerating trend. Welding, whether it is measured in terms of pounds of electrodes used, number of people employed or, as I tend to, by the rate of development, shows a similarly increasing trend.

This is not surprising since metal joining is very closely allied with the tangible products of our advancing technology.

As a result of the insistent prodding of increasingly stringent demands of advancing overall technology enhanced by the products of creative minds within the field, our fund of metal joining processes is being enriched daily by an ever increasing incidence of new developments.

✓ More research

A. R. Meyer
Research and Development Dept.
Standard Oil Co. (Indiana)

THE PETROLEUM AND CHEMICAL industries were early proponents of welding as a means to provide for safer and more reliable and efficient processing systems. Welding receives no direct identification with the ultimate product. A recognition of the positive contribution made by welding to the reliability of process and product is evidenced, however, by the direct contributions made by these industries to the development and advancement of welding methods and techniques.

The sixties will certainly see a continuation of general growth in technological competence and welding will contribute toward these advances. Both electron beam welding and plasma arc, now of primary interest for the so-called exotic applications, are already demonstrating their potential for effective use in our everyday applications.

The older welding processes are moving ahead. Automation must certainly increase as a contribution to the quality and reliability of welding. The art of welding has grown into a science and the steady infusion of young engineers trained directly in their chosen field of welding must certainly boost it to an even more solid footing.

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✓ More education

Bela Ronay
Consultant in Welding Technology

AS TO THE FUTURE of welding, it appears that it should be appraised at two levels. At one level are the large organizations serving industries which build structures and machinery designed to rigid specifications.

These groups have already developed, or are in the course of developing by on-the-job training, engineers and scientists whose competence is equal to the challenge of future problems in welding technology. At this level, the ever widening use of welding is a foregone conclusion.

The other level includes the large group of manufacturers of welded products whose combined tonnage is greater than the first group. In this second group, in the majority of the plants, neither the designers nor the production supervisors have adequate training in the fundamentals of welding technology.

The designers keep aloof from the production aspects while the production personnel blame designers for production difficulties. The result is a cold war between designers and production personnel.

The high cost of this cold war, with its attendant waste of material and labor, is borne by the unsuspecting customer. This cold war will not cease until our technical institutions relent and provide adequate training in welding technology at the post graduate level.

✓ Raw materials

W. R. Schneider
Manager
Commercial Products Dept.
D. S. Kennedy & Co.

PERHAPS ONE AREA THAT REQUIRES some consideration for future development is the area of raw materials furnished. Over the past few years processes and filler wires used have been designed and refined to a point where, in most cases, quality level of filler wires furnished far exceeds the raw material furnished. Even today a great many welding failures can be attributed to some flaw in the raw material. It would appear that some area of concentration should be exercised to improve quality level by metal manufacturers.

The problems that face us in the future could change with more pressure on colleges and universities to develop full-time courses leading to a degree in welding engineering.

Today there are perhaps less than six schools in this country that offer full study in this field.

✓ Misapplications

C. M. Underwood
Northern Ordnance Inc.

RESEARCH LABORATORIES, MANNED by usually capable scientists and practical engineers, are developing products and equipment to satisfy continually increasing demands. These scientists envision future processes and equipment that will drastically change our present methods of operation.

We can indeed look with pride on welding as an industrial giant — but is it a giant or a baby?

Our largest consumption of welding material continues to be by the original manual processes. Little time is devoted to welding applications or processes in our elementary schools and universities. Few engineers and draftsmen who determine the design and fabrication procedures of our national products have any real knowledge of the available welding processes or of their proper application. The lack of understanding of basic metallurgical principles leads to many misapplications of both material and processes by the designer and fabricator alike.

✓ Foreign competition

Roy C. Becker
Assistant General Supervisor
of Welding Research
International Harvester Co.

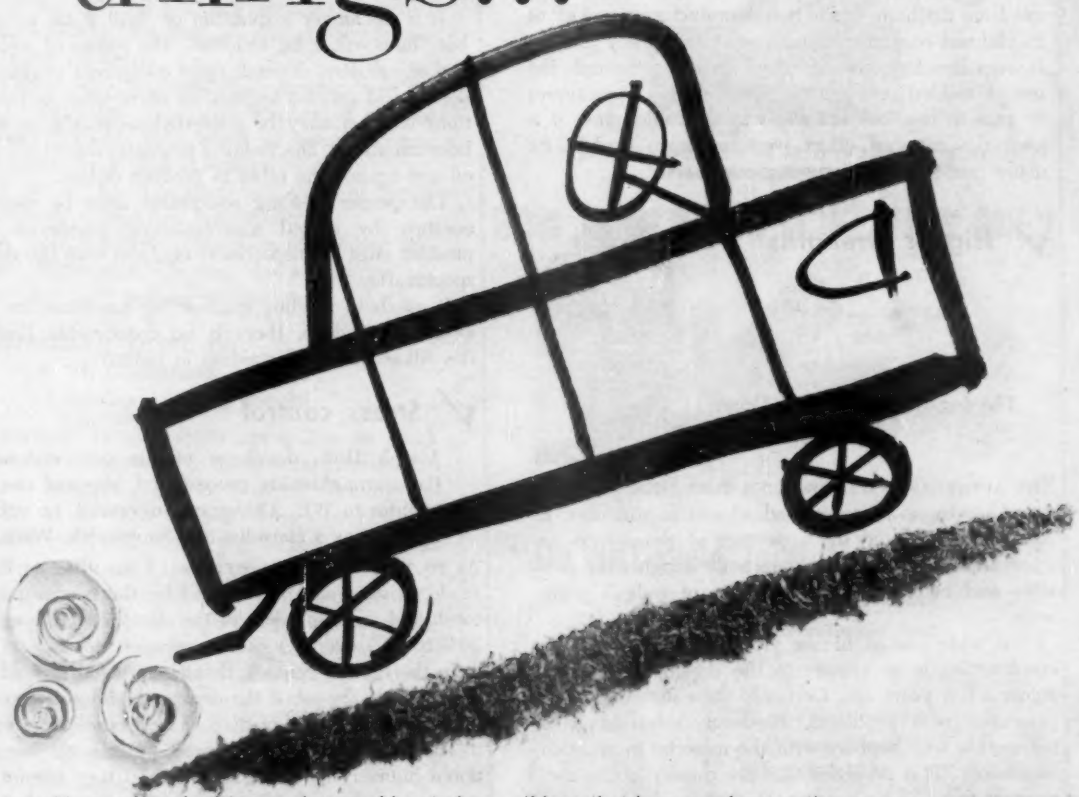
OUR INDUSTRIAL ECONOMY is currently facing grave competition from many areas. Such competition can only be successfully met through lower manufacturing costs brought about by more efficient manufacturing methods such as welding. This is only one of the many challenges which are confronting the welding industry today.

Can the welding industry meet these challenges? The welding equipment manufacturers are expanding their research and development facilities and activities. The healthy competition within the industry is supplementing the needs and challenges as mentioned above.

The users of welding equipment and processes are also becoming more and more active in welding research and development work cooperating very closely with the manufacturers. Large users of welding equipment and processes realize that they must keep abreast of the new developments making the necessary changes to suit their particular needs in order to make the most economical and timely use of the many and highly diversified welding processes.

BRIDGEPORT WELDING ROD

helps build things...



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✓ Structural

Van Renselaer P. Saxe
Engineer

IN SPITE OF ALL the favorable development toward greater use of welding in structures, we find the welding industry dragging its feet because the various manufacturers will not get together looking towards a wider use in undeveloped structural work.

Properly developed new work would produce requirements for use of additional millions of pounds of welding rod to say nothing of large additional numbers of welding machines and other equipment required to take care of a possible welding market.

In spite of the constant bombardment we engineers get from the high tensile bolt manufacturers and all of its claimed economy, which cannot under any circumstances develop economy made possible through the use of welded connections, welding slowly continues to gain in use, but not the way it would grow if a joint concentrated effort were made to explain its many merits to the designing engineers.

✓ Higher strengths

Thomas J. Dawson
The Ingalls Shipbuilding Corp.

THE ADVANCEMENT IN WELDING during the past few years has by no means solved all of the problems. It has merely whetted the appetities of those with an open mind and furnished them with insights for possible and better solutions to more of today's problems.

The wide use of higher yield materials in heavy construction is an answer to the dreams of the designer a few years ago. Certainly these materials have presented new problems. However, solutions have reasonably well kept up with the material production technology. It is proposed that the quality of the end product today is far superior to that produced only a few years ago.

Strength characteristics and performance characteristics of welded structures have played a major roll in the scientific conquest not only under the water as evidenced by our nuclear submarines, but also outer space as evidenced by the rockets of today.

Higher strength, lighter weight materials are available in increasing quantities. Modern advancements in welding technology make possible the use of these promising materials. Welding is meeting the challenge with ever-increasing higher quality weldments to withstand the rigors of modern day demands.

✓ Alloy research

Alan F. Busto, Technical Admistration, Fansteel Metallurgical Corp.

THE COMPETITION OF THE FREE WORLD VS. the enslavement by communism dictates that welding processes be used diligently in advanced military weapons to reduce weight, provide design flexibility, and produce faired surfaces at supersonic speeds.

Vital research is continuously being directed to the development of new alloys to increase strength-to-weight ratios, or to improve corrosion resistance or to extend the engineering properties in some direction. Weldability studies inevitably go along with alloy research.

It is no longer a question of "will it be welded?" but "how will it be welded?" The future of welding, and of industry, depends upon competent engineering design and process application of welding to fabrications whether they be polyethylene plastic or molybdenum alloys. The welding processes must be weighed one against the other in product design.

The proper welding equipment must be used accurately by skilled manufacturing personnel. The product must be inspected to conform with the design specifications.

If all these welding engineering functions are precisely adhered to, there is no conceivable limit to the advancement of welding in industry.

✓ Stress control

Joseph Holt, developer of the oxyacetylene flame-straightening process and frequent contributor to WE. Although semi-retired, he still operates as a consultant in Snohomish, Wash.

AS TO THE FUTURE OF WELDING, I say that anything made of steel can be repaired by the proper use of torch and arc regardless of the damage at savings of 30% to 95% over any other means of repair.

In the case of bridges, there is no need to hold up traffic to do the job if the damaged bridge is capable of supporting traffic in its damaged condition.

There were 72,000 damaged bridges on our national highways the last I heard and they cannot be repaired without holding up traffic except by my method. Many of these bridges are "workhardening" at the point of bend. In case of a national conflict, and the necessity of moving heavy equipment, what would we do if one gave way and no detour was available?

Bridges have fallen and the engineers cannot figure out why. Ships have broken in two and the engineers cannot figure out why. In the latter instances the reason was no stress control in the welding operation.

There is absolutely no excuse for a failure in any steel weldment if the stresses are properly controlled during the welding operation. If it's welded, it stays put.

✓ European trends

Carl G. Keel
Director
Swiss Welding Association

IN MY OPINION, THE FUTURE for welding and allied processes looks very bright for Europe in general and especially for Switzerland.

I have the impression that we are only at the beginning of a tremendous stride and I see the development in different ways such as:

1 — The future will bring more new and special welding processes.

2 — Future demands on the quality of welds will be greater and, in fact, sometimes too high.

3 — A trend to higher specific outputs in pounds per hour of the different welding processes. This will lead to more and more new automatic and semi-automatic welding machines.

4 — The number of welding equipments will increase. On the other hand, the number of manual weldors will decrease as a result of automatic machines handled by skilled operators.

5 — A general trend to steels and alloys of higher resistance with troublefree weldability.

6 — A more complete integration of welding machines and accessories. The costs for accessories will be higher than the machines themselves.

✓ Increasing research

R. M. Gooderham, Manager,
Canadian Welding Bureau

NEVER BEFORE, TO MY KNOWLEDGE, has so much highly trained manpower, from ingenious technician to research scientist, been devoted to welding development. As a result of such work, we have already made great strides and are, in my opinion, on the threshold of even greater ones.

In the past we have considered welding basically a problem of melting metal. With the advent of the plasma jet, we have increased our ability to do so by five or six times. We have also learned that we can join metals without melting or by melting only a minimum of material. Cold welding, friction welding, ultrasonic welding and diffusion welding are examples of this.

We also recognize that welding and torch cutting are no longer confined to metals.

The electric arc has been, and no doubt will continue to be, our chief source of heat, but even today it is a phenomenon about which we know little, but on which more fundamental research related to welding is being undertaken than ever before.

Yes, I am enthusiastic about the future of welding and chiefly because of the volume of research impelled by an increasingly competitive world — research that is going on in the great nations such as the U.S.A., Russia and Great Britain and in small countries such as Norway, Denmark and Canada.

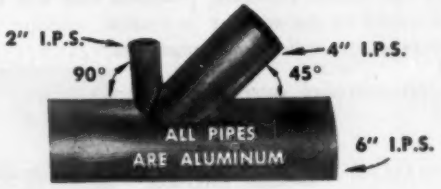
CAN YOU — IN YOUR SHOP — MAKE UP A WELD JOINT?

In less than 2 minutes?

CAN YOU THEN WITH NO DIE CHANGE MAKE THIS SET-UP?...

. . . and have both done in less than 4 minutes?

HOW WOULD YOU MAKE THIS ONE?



You could have made all 3 joints shown in *less than 15 minutes* with your

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✓ Space travel

Larry Megow
Hahn & Clay Machine & Boiler Works

ALTHOUGH THE WELDING profession has been responsible, to a great extent, for many scientific advancements in world history, there is still a great deal more to be done.

In addition to continuing the efforts for more economical welding methods, developing less complex welding machines, and minimizing the various types of electrodes, there is the most important task of perfecting present processes and procedures so that their reliability is responsible for more repetetive results.

Rockets, missiles, orbiting satellites, nuclear submarines, atomic reactors, moon shots and space flights could not have become a reality had it not been for the farsightedness of the welding profession. But the continuation of these welding advancements, without acceleration, will not make the next step — interplanetary travel — an actuality in this era.

The straight line distance to the planet closest to the Earth — Venus — is 26 million miles. Will we eventually make this trip? Yes, and perhaps not too far in the future. However, problems that will have to be solved by the welding profession, working with many other professions, are numerous.

✓ Increased automation

J. R. Wirt
Welding Engineer
Process Dept.
Delco-Remy, Div. of General Motors Corp.

WHEN WE FIND THAT A PRODUCT quality needs to be improved at lower cost, we immediately look to welding. Proper liaison between product engineers and production engineers produces designs which will attain maximum performance and minimum cost.

Precise control, rugged maintenance-free machines, and proper design for welding have built up confidence in the quality and reliability of welding to the point where more and more applications can be and are being made.

Continuing increased demand for products and the challenge of competition both in quality and price indicate a continuing increase in the use of welding in the future.

The improvement in percussive welding which allows areas of more than ½-in. square to be welded, the further development of "spike" welding and its applications, electron beam welding, ultrasonic welding, and the continued spread of techiniques and application of the old standby processes make the welding industry's future look rosy indeed.

✓ Structural welding

A. L. Collin
Chief Development Engineer
Kaiser Steel Corp. Fabricating Div.

BUILDING CONSTRUCTION WELDING offers the greatest potential for the welding industry. Building construction welding is truly an awakening giant rapidly beginning to catch up with welding in such fields as mechanical equipment and pipe lines.

Welding is made to order for modern designs with no visible means of support. However the surface has just barely been scratched and when the potential of construction welding is fully realized its future will be very bright indeed.

Just how bright this picture will be will lie in the hands of several special groups: the design engineer, the fabricator-erector, the code agency and the inspector.

As far as the code agencies are concerned, it seems almost incredible but as the welding industry pushes forward in the construction field due to great improvements in materials, processes and equipment, its own welding codes fail to keep pace and in many cases have actually impeded this progress.

The intent of the welding codes is good, but when the majority of our work has to have special prequalification on a job-to-job basis, then our codes are not reflecting the scope or type of work being done by industry.

✓ Educate engineers

P. V. Pennybacker, Design Engineer, Public Works Dept., Austin, Tex.

IN MANUFACTURE THERE WILL BE competition of materials as well as joining methods. The industry which produces metals and the welding industry must cooperate in a joint effort to retain and expand their market in that industry which manufactures the end product for sale to the ultimate consumer.

Now as for structures for building frames, bridges, and such where the product is not produced for a mass market, the market has hardly been scratched, and there is little evidence it will be improved as rapidly as it should. The industry has the knowledge, but the consumer does not.

It is my opinion that, except for a small percentage who are doing an outstanding job for their clients and employers, the part of the engineering profession which is responsible for design and construction of framed structures needs a lot of education on the possibilities which welding offers to them and their clients. And it is also my opinion that the welding industry, working through the AWS, should assume the responsibility for making such education available to those engineers who began their practice before welding was as ready for use as it is today.

SILVER BRAZING SIMPLIFIED NOW, WITH FIRST FLUX-COATED ROD!

EutecSil® 1020 FC*... first flux-coated silver alloy ever available...new concept, new combination from core to coat... a fresh success from Eutectic's research. Biggest news is in the benefits to weldors: *no more fluxes to mix, apply, dry!* Flux always present in right amount. Ferrous, non-ferrous metals, joined equally well. Highest fluidity, lowest melting point, greatest strength. And more...

BENEFITS NEVER END...In addition to easier application and all the other features listed above, EutecSil 1020 FC is non-toxic: you can use it on food equipment. Also, it contains a built-in oxide remover. And EutecSil 1020 FC does not deteriorate. Unique flux eliminates "stub loss" between rods. Add to these advantages the fact that you stock only one product instead of two yet get a better joint, and you see why EutecSil 1020 FC... the latest "first" from Eutectic's research...is the greatest news of the year for weldors.

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Centering Heads

Actually, it's five tools in one — replaces protractor, centering head, center punch, level and scale. Y-Type head is accurately machined with tangents and tips to serve in centering and aligning. Dial Set Level is marked in 2½ and 10 degree graduations for easy reading. Punch is of drill rod, with special point for long service.

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This self-centering tool makes pipe line construction faster and more accurate. It is quickly adjustable for all type flanges or pipe sizes ranging from 3 to 12 inch diameters. After easy insertion into pipe, Flange Aligning Tool centers itself snugly against the inside pipe diameter and automatically aligns with pipe axis.

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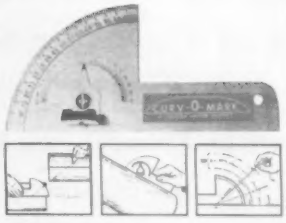
The ANG-LO-CATOR Protractor is the only measuring device that quickly and accurately determines correct degree of angle on any pipe or structural material, regardless of size. A valuable aid to welders, structural workers and pipe fitters. Size 4" x 8".



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✓ Shadows, too

R. David Thomas, Jr., President, Arcos Corp., President, AWS.

SURE THE PICTURE for the welding industry looks bright. But, like any pleasing picture, there are highlights and shadows. In speaking of the industry's glowing future, let's consider not only the bright spots but also the areas which are not so bright.

In the deep shadows, inadequately illuminated because they spoil the pleasing nature of our picture, are two areas of concern to those of us intimately connected with welding. The first is the inadequate training being given our engineering graduates in the welding sciences and technology. The general public's picture, and hence the engineering campus picture, of a welding engineer is one of a man who holds a welding torch or an electrode holder and repairs automobiles or railroad rails. Until this impression is replaced by images as attractive as those in the space sciences or in electronics, our development in the coming decades will suffer.

The second concern is in the field of research. The country has held a world-wide reputation for its advances in welding and, while many forward-looking companies have plowed back huge sums of money into their research programs, our rate of research expenditure for welding is not now sufficient to retain the leadership we have already established.

This research effort can only be justified in our competitive enterprise system by prospects of future profits. Today's profit-sharing picture in the welding industry is seriously impaired by short-sighted marketing practices which may buy immediate volume at the sacrifice of long-range economic stability. In such an atmosphere, research is apt to be stifled.

✓ Responsibility

Stanley I. Roberts
Head Welding Engineer
Portsmouth Naval Shipyard

IN OUR GENERATION WE HAVE SEEN, broadly speaking, three stages in the development of welding. These, of course, are not all-inclusive but encompass to a degree the overall picture of our growth.

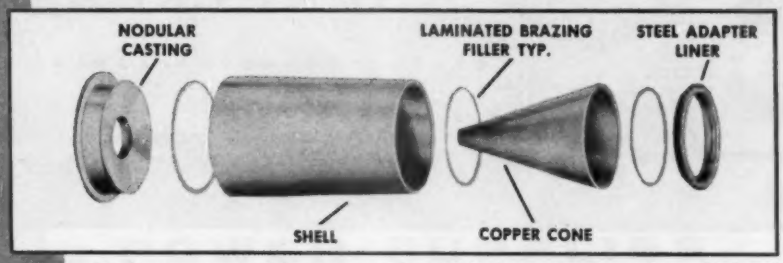
First, the fix-it stage.

Second, the competitive stage.

Third, the proprietary stage.

The future of welding, in its fullest extent, is not assured. The proprietary aspect is enviable indeed, but it places a burden of responsibility upon the welding industry.

How we react to this position depends on our approach to the problems associated with welding, such as development, quality, inspection, standards, qualification, new materials, education, and practical production methods — in short, giving industry a welded joint of maximum performance and minimum expense.



The four components of the nose assembly—nodular iron casting; low-carbon welded steel canister which measures 34" long, 15½" diameter at one end and 17¾" at the other; spun copper cone and low-carbon steel ring. The thinner rings are Easy-Flo 45 wire braided for precise alloy position and control.

Martin Develops New Induction Heating Methods to Braze Lacrosse Missile Assembly With EASY-FLO 45

One of the largest assemblies yet brazed by induction-heating techniques is a section of the Lacrosse missile being manufactured at The Martin Company's Baltimore Division. During development, one problem was posed by the variety of metals used. First it was necessary to braze a low-carbon welded steel canister and nodular iron casting. Then, to complete the assembly, a spun copper cone and low-carbon steel ring were joined to the canister. An induction coil was designed by Martin to accomplish this critical operation. Temperatures had to be restricted between 1300 and 1350°F to prevent a transformation change to the crystalline structure of the nodular iron. Martin's Materials Engineering Laboratory made careful examinations of this assembly and found that Handy & Harman Easy-Flo 45 Silver Brazing Alloy and B-1 Flux make possible the strong, uniform joints necessary to meet the stringent requirements the Company has set. Its low-working temperature, high strength, fast penetration and flow characteristics are only a few of the features which make this brazing alloy ideal.

More and more aircraft and missile components are being made with the aid of Handy & Harman silver brazing alloys and flux. The products described here are just two of the many available to help solve your problems...make your job easier and quicker. For a more complete picture of silver brazing and the advantages it offers you, write for your free copy of Bulletin 20.

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the welding clinic
Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Here's how to weld Ledloy steel

In the December issue of WELDING ENGINEER, *The Welding Clinic answered a question on the weldability of Ledloy steel. Since then so much interest has been generated concerning this steel that WE felt some additional data would help solve any further problems.*

Using coated metal-arc electrodes, such as E6030, E6020 and E7018 grades, A. O. Smith Corp.'s welding research laboratory recently evaluated the weldability of Ledloy steel.

These tests indicated that Ledloy steel is of weldable quality and can be successfully welded with E7018 electrodes.

Weldability tests were made in shallow grooves with the E6020 and E6030 electrodes, but were not satisfactory because of surface porosity and pitting. However, the other tests made with E7018 electrodes were satisfactory when made in the same type shallow grooves as well as in butt joints. In addition, spectrographic analysis showed weld metal deposited with E7018 was free from lead.

The shallow groove welding tests were made with ¼-in. electrodes, without preheating, at 6 ipm.

For the butt-weld test a standard U-groove was welded with E7018 electrode. The welding sequence consisted of using a 3/16-in.-diameter electrode for the first layers, followed by a ¼-in.-diameter electrode for the balance of the weld with a double pass technique.

The back side was flame-gouged to a depth of ⅜ in. and a width of ⅝ in. to remove any unfused metal and then welded with a 3/16-in. diameter E7018 electrode for one layer followed by a ¼-in.-diameter electrode for the second layer and completing the last layer with 3/16-in. diameter.

In the tests, simple pass welds were made in shallow grooves on the plate surface so that any reaction, due to lead content of the steel, would be reflected in the weld area in the form of pits, porosity and cracks.

In the as-welded condition at 78,800 psi and 80,800 psi tensile strength and in the stress relieved condition at 70,300 psi and 72,200 psi, the failure was always in the parent metal when using E7018 electrode.

The side bends tested from the test plate in the as-welded and stress relieved conditions were satisfactory to 180 deg.

Samples from the butt joint weld made with E7018 electrodes were analyzed and showed the following results: carbon, 0.04; manganese, 0.77; phosphorus, 0.021; sulphur, 0.019; silicon, 0.66.

All welds were free of lead and lead was not picked up from the parent metal due to dilution factors.

Question:

What are the physical metallurgical differences between 310-15 *and* 310-16 *d-c deposited weld metal?*

Answer:

According to most manufacturers, there is little difference in the deposited weld metal of the stainless electrodes 310-15 and 310-16. The chemical analysis of the direct current electrode, that is the 310-15, is 25% chromium and 20% nickel. These are minimums.

The maximum amount of manganese is 2.5%, and the range of carbon is 0.09% to 0.12%. The only difference in the a-c/d-c electrode, that is the 310-16, is that its carbon range is 0.09% to 0.15% and contains molybdenum from 0.60% to 0.90%.

The coating minerals of the d-c electrode are limited to inorganic compounds such as calcium flouride, calcium carbonate, magnesium-aluminum-silicate, ferro alloys and such binding agents as sodium and potassium silicate. These electrodes are known as lime-ferritic because of lime-type coatings.

In the 310-16 electrode more potassium silicate or other potassium salts are added to the coating to make the electrode suitable for use with a-c as well as with d-c reverse polarity. The latter are usually titania-type coatings.

In transfer of the core metal through the arc, very little nickel is lost from nickel-bearing stainless electrodes. There is a slight loss of chrominum and a greater loss of the other elements. Naturally, there is also a greater loss of the coating materials.

Generally speaking a-c/d-c electrode deposits are higher in tensile and yield strength and have better elongation properties.

How much of each of the constituents ends up in the weld metal is a little difficult to ascertain without making a regular analysis of the deposit, since electrodes manufactured by different firms will vary slightly within the boundaries set up by AWS specifications.

Model 500-40 VS
(500 amp rated output)

For jobs where only the best will do—

NEW GLENN VARIABLE V/S SLOPE

CONSTANT VOLTAGE POWER SUPPLIES

for all consummable-electrode automatic and semi-automatic welding processes, including:

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New GLENN V/S power supplies are totally new from basic transformer design to their exclusive new linear slope control. They can be precisely "tuned" to the exact arc characteristics needed to produce any type of metal transfer and deposition desired. The result is improved weld quality, appearance, speed and economy.

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WHEN SPECIFICATIONS ARE CRITICAL and weld quality, uniformity and appearance must be kept high, you'll be hours and dollars ahead to specify GLENN V/S power supplies. Why not get the facts? Write us today for literature, specifications; please address Dept. 137.

Basic features

1. **NEW TRANSFORMER DESIGN** increases efficiency, improves voltage regulation and minimizes effects of line voltage fluctuations.

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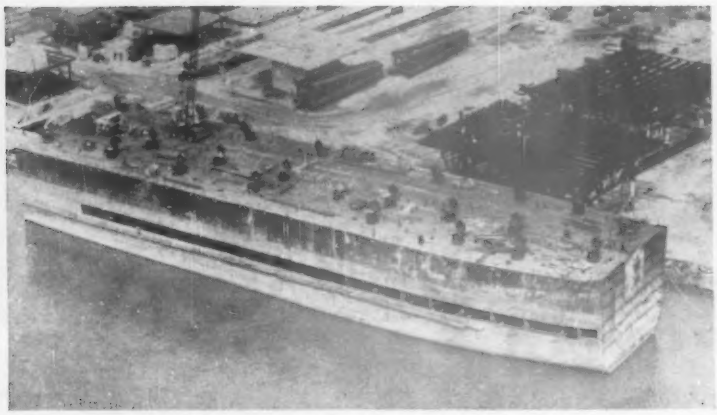
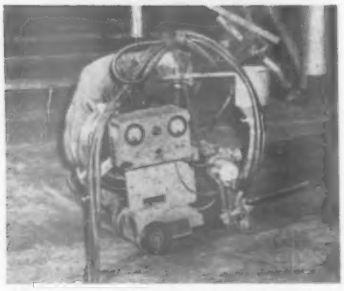


HORIZONTAL band is removed from oil-tanker midsection to begin severing operation which resulted in two barges.



SUBMERGED-ARC machine welds deck plates in "slot" between upper and lower barges.

Two for the price of one . . .

Submerged–arc welding helps build "split" barges

by H. W. Bailey
and R. S. May*

THE LOUISIANA BAYOU country got a taste of the unusual recently when an old tanker midsection was saved from the scrapyard and transformed into two ocean-going deck cargo barges.

The operation, depending heavily on submerged-arc welding, was done by the J. Ray McDermott & Co., Inc., Morgan City, La., at Bayou Boeuf.

Left over from a wartime T-2 tanker which was being enlarged, the midsection measured 261- by 68-ft. After a horizontal band was removed, two new deck sections were inserted at the cut, and new rake sections replaced the blunt bulkhead ends. The old midsection deck was then stripped down and modified to become the bottom of one barge.

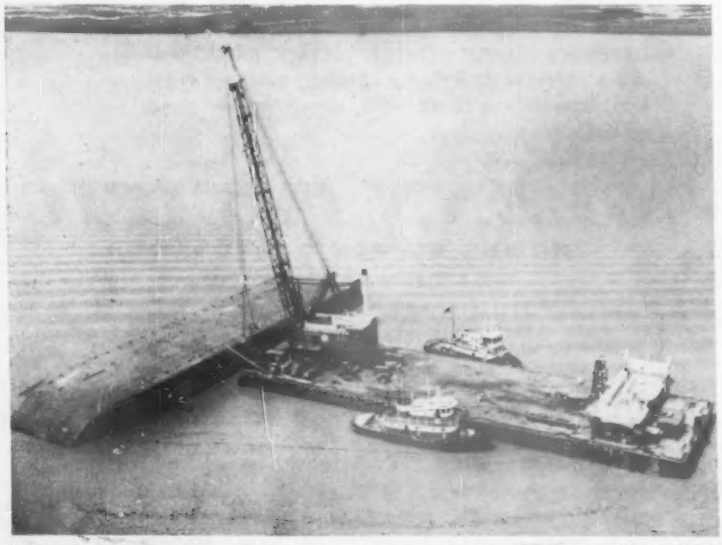
After the bottom section was sunk, the top portion was floated off and turned over in midstream of the Atchafalaya River. Two barges emerged from this tanker-splitting operation.

The ½-in. by 10- ft by 40-ft carbon steel deck sections were seam-welded with submerged-arc equipment from Linde Co., New York City, using a ½-in. gap over 1- by ¼-in. backing strips. An 800-amp, 33-volt welding current eliminated the need for beveling the deck plates; pre-welding preparation was reduced to wire brushing.

All seam welds joining the new plates were made with submerged-arc welding heads, travelling at a speed of 13 ipm. Carbon steel wire, 3/16-in diameter, and grade 50 flux composition were used.

The McDermott firm has produced six of these barges, which are classed for ocean travel by the American Bureau of Shipping. They have made numerous trips to Venezuela, Trinidad and throughout the Gulf of Mexico.

*Mr. Bailey is general manager of J. Ray McDermott & Co., Inc. and Mr. May is a welding sales engineer, Linde Co., New Orleans.



FREE-FLOATING upper barge is turned over in the Atchafalaya River channel by a floating crane.

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three phase rectifier ***IDEALARC R3M®***

DC arc welders

Announcing a new family of ***LINCOLN WELDERS***

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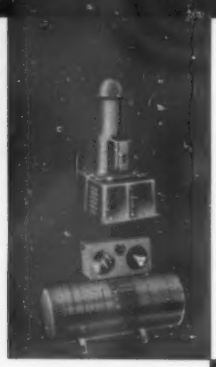
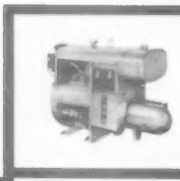
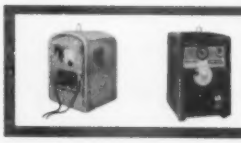
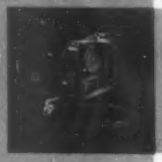
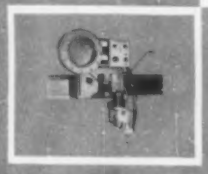










IDEALARC
R3M-400
LINCOLN
WELDER

A great new addition to the World's Most Popular Line of Welders

Lincoln's all new IDEALARC R3M

three phase rectifier DC arc welder

With such a large group of Lincoln welders already available to meet the needs of welding users, you might wonder why the new Idealarc R3M is necessary. Here is the reason—on some applications the following are either necessary or highly desirable:

1. DC welding current for small sized electrodes or stainless steel, alloy, non-ferrous or other special electrodes.
2. A current range broad enough to handle both semi-automatic equipment and small manual electrode.
3. A balanced, three phase input current.
4. Quiet operation.
5. Low idle currents.
6. High power factor and efficiency.

Only in a three phase rectifier, such as the new Idealarc R3M, can all these features be incorporated into one machine.

In addition to these features, the rugged construction of this new Lincoln welder promises to set new high standards of trouble-free operation and minimum maintenance. The highly efficient silicon rectifiers do not age or deteriorate and are exceptionally well protected against overloads with special electrical circuitry.

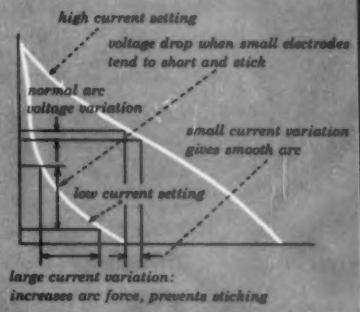
APPLICATIONS

For Manual Welding—The Idealarc R3M will handle *any* manual electrode. Its output characteristics produce smooth, steady, spatter-free welding at high currents and strong current surges that prevent sticking at low currents. In the production plant, maintenance shop, or the construction site, your operators will enjoy using the Idealarc R3M.

For Semi-Automatic Welding—The larger sized Idealarc R3M's, equipped with the optional "Power Pack", can be used as a power source for Lincoln's submerged arc Squirt Welders or other semi-automatic equipment. Equipped with two sets of leads, one Idealarc R3M can be used alternately for both manual and semi-automatic welding—double duty for added versatility and reduced capital investment!

PERFORMANCE FEATURES

Output Characteristics—Idealarc R3M has unique and important built-in characteristics that make welding easier. First, to prevent sticking with small electrodes, the machine produces a surge of current as arc length is shortened. This surge, seen as the "toe" of the low current settings curve, eliminates the need for separate switches and circuits to prevent sticking.


high current setting
voltage drop when small electrodes tend to short and stick
normal arc voltage variation
small current variation gives smooth arc
low current setting
large current variation: increases arc force, prevents sticking

Second, for smoothest operation of large electrodes, the output curve at high current settings is quite flat and relatively unaffected by arc length variations. There is minimum spatter and "wild arc" action.

Third, for maximum arc stability, R3M's choke coil is designed so that any electrode can be run at any appropriate current, using any technique, with complete freedom from pop-out.

Input Power—The Idealarc R3M draws a balanced three phase current from the lines. Particularly important where machines are installed on existing lines, this characteristic usually permits direct replacement of obsolete welders with new Idealarc R3M's without installation of additional wiring, switches or fuse boxes.

Starting and idle current on Idealarc R3M welders is practically nil, amounting to less than 15% of the rated input current. On field applications, the number of machines which can be powered by one generator set depends only on usable rated current, not starting current.

Power factor is high and idle amps low on the Idealarc R3M. Efficiency is excellent. Overall, for machines operating at rated load, efficiency is about 75%. Note that the silicon rectifiers contribute considerably to this. They are about 4 times as efficient as selenium rectifiers.

You'll find the Idealarc R3M welder truly ideal from the standpoint of every input power consideration.

Low Cost—After you've checked the performance and construction features of the Idealarc R3M and convinced yourself that it is tops in its class, then look at its price. You'll be pleasantly surprised.

LINCOLN IDEALARC R3M
Three Phase Rectifier, DC Arc Welder

CONSTRUCTION DETAILS

Current Control — An easily turned crank on the front of the machine provides continuous current control over the entire range of the machine by a movable core in the reactor windings. The mechanical system used to move the core is rugged, noise-free, smooth and free of creeping problems.

Polarity Switch — Durable, silver-plated contacts with sturdy mechanical construction assure thousands of trouble-free polarity changes.

Case — The recessed front prevents damage to external controls. Output studs are recessed even further and separated to eliminate accidental shorts. Strain relief loops prevent needless wear on output studs and loose connections that dissipate output and cause operator annoyances.

Lift Bail—Whether you move your machine once or hundreds of times, the convenience of the sturdy lift bail will be apparent. Welded directly to the sturdy frame of the machine, the lift bail is attached permanently regardless of how severely it is used.

Signal Light — Red light indicates machine is on; prevents accidental idle operation during non-working hours.

Line Contactor Starter and Overload Protection —Operated by a push button on the front panel, a heavy duty magnetic contactor energizes the machine. Protective circuits automatically disconnect the welder from the line in the event of overload, overheating from any cause, or input power failure. This well-proved protective system makes it virtually impossible to burn out the Idealarc R3M.

Weatherproofing — Louver design prevents entry of rain, or other falling liquids, into the machine. Also, electrical parts receive a double dip in a special insulating material after they are assembled and interconnected to repel the attack of salt air or other corrosive atmospheres.

Silicon Rectifiers — After years of testing, Lincoln engineers are convinced that the silicon diodes and circuitry employed in the Idealarc R3M provide unequalled rectifier performance and life. To the well-established efficiency and freedom from aging of silicon diodes, Lincoln has added exceptionally large safety margins and unique protective circuits to overcome the problem of overvoltage failures that plagued silicon rectifiers in the past. The results are outstanding.

Windings — Most of the windings in the Idealarc R3M are aluminum, which permit a compact, lightweight design. As in other Lincoln welders the aluminum-copper connections are flash-butt welded and sealed forever in a protective coating. There are no mechanical aluminum-copper joints.

Fan and Cooling System—A large fan moves generous quantities of cooling air through the machine. Clean air flows in at the top of the welder, passes first over the rectifier heat sinks, then down over the windings, and exhausts through louvers in the front panel. A large safety factor in temperature rise, designed in the machine, permits the use of the Idealarc R3M on even unusually severe applications.

SPECIFICATIONS

		Idealarc R3M			
Model	60 cycle	K-1149	K-1150	K-1151	K-1152
Type	50 cycle	K-1153	K-1154	K-1155	
NEMA Rating:	Current	300 amps	400 amps	500 amps	650 amps
	Arc Voltage	40 volts	40 volts	40 volts	40 volts
	Duty Cycle	60%	60%	60%	60%
Current Range		30-375	40-500	50-625	65-750
Input Power:	Voltages*	208, 220/440, 220/550 volts			208 220/440
	Cycles	60 and 50			60
	Phase	Three Phase			Three Phase
	Rated Current (220 volts)	58 amps	75 amps	94 amps	120
	Idle Current	9 amps	11 amps	13 amps	13
	Power Factor @ Rated Load	74%	76%	75%	74%
Weights (Approx.):	Net	586 lb.	675 lb.	800 lb.	910 lb.
	Domestic Shipping	650 lb.	739 lb.	864 lb.	974 lb.
	Export Shipping	731 lb.	820 lb.	945 lb.	1055 lb.
Dimensions (all types)		Height	Width	Depth	
	Machine, overall	39⅞"	26⅛"	28½"	
	Export Crate	55"	36"	36"	

*220/380 and other single voltages available on special order

OPTIONAL FEATURES

(at slight additional cost)

Undercarriage—provides portability. A sturdy three-wheeled undercarriage with either steel (K-726) or solid rubber tires (K-726R) is available for field installation.

Remote Current Control — Changes machine current setting from the operator's station with a simple toggle switch. The switch operates a motor inside the welder case which rotates control crank to adjust current up or down. Available factory-installed only.

ML-2 Power Pack—provides 115 volt DC control power and other circuits necessary for Lincoln ML-2 Squirt Welder. Available as a kit for field installation.

115 Volt Starter Circuit—for plants with regulations requiring 115 volts on starter push button circuits. Available factory-installed only.

Accessory Kit — includes headshield and lenses, electrode holder, ground clamp, and cables. Priced below total price of individual components.

Remote Polarity Control — Change from DC (+) to DC (—) or vice versa, with a switch attached to the electrode holder or mounted at the operator's station.

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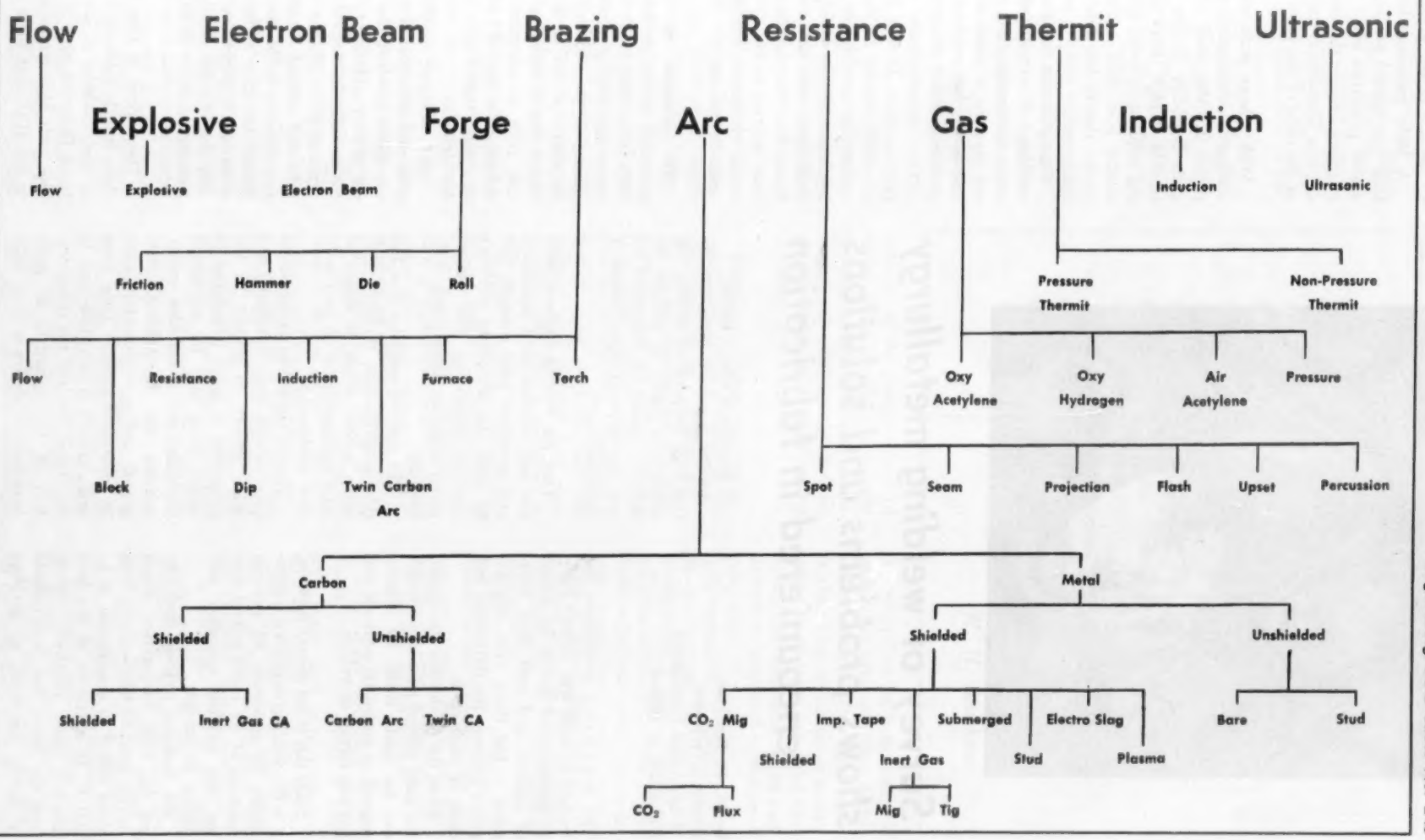


Survey of welding metallurgy shows problems and solutions encountered in fabrication

by W. H. Bruckner
Research Professor
Metallurgical Engineering
University of Illinois

THE WELDING PROFESSION has learned to work with today's highly sophisticated metals by means of preheat and post heat treatment — but these extra requirements increase the difficulties and costs of production.

From the production standpoint, the ideal welded joint is one which can be made easily by existing manual or automatic methods and put into service as-welded.

Since this is not always possible, it is the welding engineer's responsibility to anticipate all possible reactions of the metal system during the welding operation and during its service.

For example, welding steel piping for high temperature steam service involves temperatures from about 800 F to a maximum of 1,200 F. In a portion of the heat affected zone, relatively remote from the fusion line, iron carbide is slowly converted to graphite and provides a site of failure.

In the as-welded condition before high temperature service, the susceptible region of carbide instability cannot be discovered by any current metallurgical means of examination.

Thus, the welding engineer must not only control weld soundness and as-welded joint strength, but he must also anticipate welding's possible effects on the welded joint's in-service stability and/or its integrity.

(The welding engineer now has this graphitization problem well under control either by means of steel composition or by post weld heat treatment.)

There is more than an occasional concern with grain boundaries and grain growth in respect to the properties of grain boundaries in which there may be segregated impurities such as carbides, oxides, sulfides, etc. In welding, grain growth and grain boundary must be mentioned together since some grain growth is inevitable next to the fusion line and the concentration of the segregate at grain boundaries is always in direct ratio to the size of the grain.

A little contamination goes a long way toward producing undesirable properties when grain size increases because the grain boundary area decreases as the reciprocal of the cube of the grain diameter.

With a large grain size a small amount of contaminant may completely fill the small area at the grain boundary. It can also give trouble at high temperatures during welding, at lower temperatures during post weld cooling, or in service due to hot shortness or to brittleness.

Examples can be seen in the welding of oxygenated copper, where hot cracking and cold cracking may be a common problem, and in the hot cracking of steels containing sulfur and phosphorous.

The special grain boundary problem with 18-8 stainless steel is widely known in the welding industry as being due to a sensitizing heat treatment which occurs in welding at some distance from the fusion line. The carbon is rejected from solution in the austenite and forms chromium carbide at the grain boundaries.

The presence of the grain boundary precipitate adversely affects the welded joint's mechanical properties. But of greater consequence is the reduced corrosion resistance of the grain boundary region due to depletion of chromium. With an aggresive corroding solution, the welded joint may fail in a short time due to intergranular corrosion.

The welding metallurgist has presented a number of solutions to the above problem, one being the use of alloy additions to "stabilize" the carbides. Adding columbium or titanium as an alloying element in sufficient amount removes carbon from solution in the austenite. The reason: the alloy addition carbide is formed in preference to chromium due to the strong carbide-forming tendency of either metal.

The carbon is thus fixed and there is little tendency for solution of such carbides at low temperatures. However, close to the fusion line such high temperatures exist in the HAZ that there is solution

and high diffusion rate.

So, unless the welding method assures a minimum time at the high temperature, extensive rejection of the refractory and stable carbides at the large prior austenite grain boundaries next to the fusion line will occur.

Even if high temperature time is not long enough to move much columbium by diffusion to the grain boundary, there still is considerable solution of the refractory carbide in the austenite.

Reheating of this austenite in multipass welding causes the preferential precipitation of chromium carbides at grain boundaries close to the fusion line where the refractory carbides have gone into solution. The result is the so-called "knife line" corrosion failure next to the weld.

In this case one headache is eliminated (the rejection of chromium carbide and intergranular corrosion remote from the weld) and another closer to the weld is created.

Recognizing that both problems are basically due to the presence of carbon, the metallurgist developed ELC (extra low carbon) stainless steel and provided complete freedom from welding problems involving carbide formation.

However, the high cost of ELC may at times make this solution to the welding problem inappropriate.

There are other grain boundary problems in welding metallurgy, but one more example should suffice to illustrate the extra importance of grain boundary reactions for successful welding operations.

The low melting temperature obtainable with an eutectic alloy composition is well known. The eutectic may be a boon to a brazing operation, but in welding the rejection of a low melting eutectic at the grain boundaries can spell disaster. Liquid films are formed which separate solid grains and cause rupture at high temperature. The latter occurs under tensile stresses derived from the accommodation of the base metal to the welding cycle.

When resistance spot welding certain aluminum alloys, the answer to the problem is simply adjustment of the pressure cycle to permit the material to cool under compression. Thus, welding metallurgy is inevitably tied to the state of stress peculiar to the welding conditions employed.

"The metallurgy of welding is known as the metallurgy of small masses and is thereby distinguished from conventional metallurgy dealing as the latter does with large masses subjected to relatively low heating and cooling rates. The heat affected zone of the base metal of a fusion weld represents another departure from conventional metallurgy in view of the extremely elevated temperatures to which parts of the HAZ near the fusion line are raised . . . The reason we can 'get away with' the unconventional heat treatment in welding is the short time during which the small masses involved are thermally cycled."

W. H. Bruckner

Successful welding may be accomplished either by avoiding an unfavorable stress state or by limiting it to a minimum duration. Cracking due to hot shortness (*e.g.*, from sulfides in steel sheet) may be reduced by employing a cooling cycle so rapid that the material is in the hot-short temperature range for a minimum of time.

Actually, avoiding hot cracking due to sulfur and phosphorous is more complicated metallurgically than the solution implies. Some steels are more resistant to hot cracking as the amount of sulfide contamination is increased beyond a critical range, thus changing the amount of the eutectic, its composition or its properties.

The existence of binary eutectics freezing at constant temperatures may provide freedom from hot cracking, if the latter is associated with the existence of a ternary eutectic.

The subject of stress would not be complete without noting a very beneficial effect in manual welding structural steel with covered electrodes. The weld deposit in structural steels has higher mechanical properties than the base metal, although the latter may have higher carbon content. The weld metal produced has, to be sure, a smaller grain size than the hot rolled base metal, and thus some of its high strength is attributed to the small grain size.

However, a large contribution to the strength of the weld metal comes from a high temperature strain aging reaction. The plastic strain in the weld metal, due to the high stress level while cooling, causes a general dispersion of precipitated oxides and nitrides which contributes to the weld metal's high strength.

Fortunately, there is just enough contamination from oxygen and nitrogen when manual metal-arc welding to raise properties without causing embrittlement.

A full heat treatment of the welded joint in structural steel may reduce weld metal properties seriously below those for the as-deposited state. The reason for this is an increase in grain size and resolution of the contaminants.

In addition, there is no large plastic strain on cooling to cause the desirable re-dispersion of precipitates by strain again. Where a full heat treatment is necessary, the weld metal composition must be adjusted to match the base metal properties after heat treatment.

This has been successfully done on the SAE 4340 steels for which

"Full heat treatment of the welded joint in structural steel may reduce weld metal properties below those for the as-deposited state."

electrodes are now available to provide up to 280,000 psi in the quenched and tempered weld metal.

The welding metallurgist has many other problems which a general survey should mention.

Among the problems is hydrogen and its effects in producing micro-cracks and fish eyes in weld deposited steels. Microfissuring is intensified by increasing either the hydrogen, cooling rate or restraint in welding since the presence of cracks depends simply on hydrogen content of the weld metal and the stress level attained at temperatures below 400 F.

The cooling rate may be effective both in determining the hydrogen content and the stress level, and thus, a low cooling rate may permit a larger amount of hydrogen release, a lower stress level and may avoid cracking.

One aspect of weldability is considered here: the uniform response of steels to the thermal cycle in the HAZ. In the hot rolled condition, the cooling rate on the hot bed at the end of the rolling mill can vary over a wide range from plate to plate or bar and from edge to center of rolled shapes and plates.

Consequently, the microstructure will show a wide variation in the geometry of the carbides and their distribution, as well as in the size of austenite and ferrite grains.

Carbide behavior in the austenite, as well as at subcritical temperatures in the HAZ, depends on the available carbide surface for solution and diffusion. The smaller the carbide particle size, the more rapid the solution rate in austenite and the more rapid their growth at subcritical temperature.

Differences in hardening at and near the fusion line will result from rapid welding methods. When slower rates of welding are used, differences in maximum hardness may disappear, but softening due to spheriodization remote from the fusion line may show a considerable variation.

The term weldability for such material is meaningless since there is no uniform response to the heat input during welding. The benefits obtainable through uniformity of microstructure are well illustrated in the experience with the tee bend test for weldability by L. C. Bibber, chief research welding engineer, U. S. Steel Corp.

In many cases his weldability rating was low for the as-rolled steels, but became entirely satisfactory and uniform when the same steels were normalized before welding to produce a uniform microstructure.

In the non-ferrous applications, the joining of aluminum and other alloys (which derive their most useful properties through a solution and aging heat treatment) has presented many problems.

Today, Mig and Tig welding with their high intensity thermal source have been so effective in high speed welding that some 6061 T4 aluminum alloys may be welded in the naturally aged condition. They are then given an elevated temperature aging and have 85 to 97% of base metal properties in the joint.

This is a remarkable achievement considering the difficulties of just a few years ago regarding unsound weld metal from coated electrodes and drastic overaging from multipass welding.

With today's technology, many more of these highly important alloys can be considered weldable in the solution treated condition where previously only the annealed condition merited such consideration.

The mathematics of welding metallurgy has taken a giant step with development of certain equations. It is now possible to calculate peak temperatures as a function of distance from the weld centerline and cooling rates — given the current, voltage and welding speed.

Equations developed from aluminum and presented as a plot of peak temperature against a relationship between plate thickness, welding speed and power, yield a straight line whose slope becomes the efficiency of thermal transfer from arc to the metal plate.

Use of the mathematical derivations makes possible the calculation of welding speed and power input for a fusion welding operation, which is required to prevent microcracking due to hydrogen or to reduce the properties of a cold rolled material beyond certain limits.

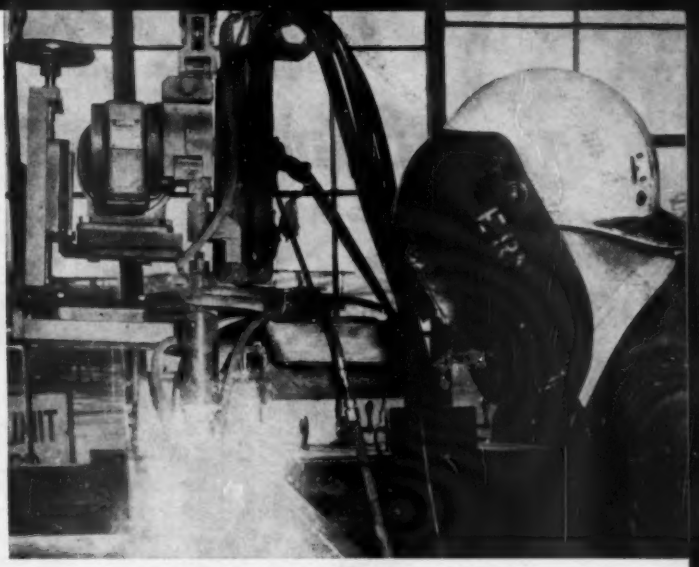
The metallurgy of welding moves forward at a rapid pace and presents an ever increasing challenge to the ingenuity of the welding engineer to make use of the newly developed resources for the solution to his problem.

"In manual welding . . . weld deposit has higher mechanical properties than the base metal."

This article is based on a talk presented at the First Biennial Short Course on Welding Engineering conducted Dec. 5-8 at the University of Illinois.

Greater economy, less total heat input, fewer passes, greatly increased speeds when . . .

Square-butt Mig welding joins aluminum cylinders



MIG square-butt welding of heavy-wall aluminum cylinder at 8 ipm.

A NEW TECHNIQUE called square-butt Mig welding is being used to join heavy-wall aluminum cylinders for nuclear equipment.

Welding of the cylinders by National Steel and Shipbuilding Co., San Diego, is now more economical and can be done with less total heat input, in fewer passes, and at greatly increased speeds.

Previous metal-arc welding of the 1¼-in.-thick aluminum cylinders required:

1—Open-vee beveled edge preparation.

2—Gas welding-torch preheating to 350 F.

3—Welding one joint side, then back chipping and welding the opposite side.

4—Several stringer-bead passes to complete the joint.

Square-butt Mig welding (also known as "high-current" welding) eliminates these steps. Only a clean, square, end-to-end joint is required. Where minimum weld reinforcement is desired, a shallow vee-joint may be used. Single-pass Mig welds, one from each side, result in full build-up and pentration, and radiographic tests show 100% water-clear welds.

The new technique enables heavy aluminum plate welding at currents well above 400 amp. Before this, attempts to exceed 400 amp resulted in arc instability, severe oxide folds between weld layers, and weld porosity.

Square-butt welding overcomes arc instability by incorporating improvements in gas shielding and purity, wire quality, and the slope-controlled power supply.

Higher-current Mig welding (up to 600 amp d-c reverse polarity) eliminates porosity by increasing heat input at the weld zone since

Square-butt welding conditions

Plate Thickness (In.)	Wire Diameter (In.)	Shielding Gas Argon cfh	No. of Passes	Welding Speed (ipm)	Current (amp) DCRP	Voltage (v.)	Approximate Wire Feed Speed (ipm)
1/4	3/32	80	1	23	370	24	170
1/4	1/16	60	2	35	280	23 - 24	240
3/8	3/32	80	1	18	420	24 - 25	200
3/8	3/32	80	2	28 - 30	350	24 - 25	155
1/2	3/32 or 1/8	100	1	14 - 15	490	25	3/32 wire - 210 1/8 wire - 125
1/2	3/32	80	2	23	430	25	205
5/8	3/32	80	2	18	430	25	205
3/4	3/32 or 1/8	100	2	16	450	25 - 26	3/32 wire - 210 1/8 wire - 125
1	3/32 or 1/8	100	2	10 - 12	500	25 - 26	3/32 wire - 240 1/8 wire - 135
1-1/4	1/8	100	2	8 - 10	550	26	145
1-1/2	9/64	100	2	8	590	26	130

Note: All edges are prepared by Tig cutting or shearing with edges filed. All joints are square-butt, but a variation may be employed whereby weld reinforcement is reduced to a minimum through joint design consisting of grooved or beveled plate edges. Under such conditions, welding procedures will be the same, with perhaps somewhat higher travel speeds and lower currents than shown above.

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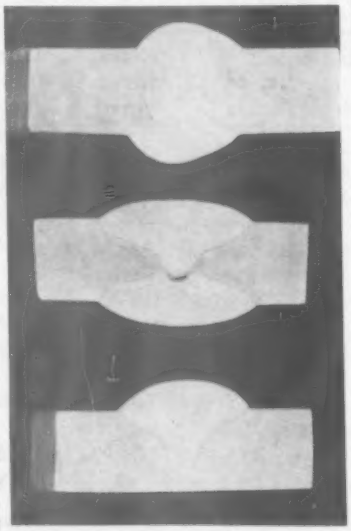
ONE-PASS weld made from inside cylinder at 400 amp and 27 volts d-c reverse polarity with 3/32-in.-diameter aluminum wire.

the puddle remains molten long enough for porosity-forming gases to bubble out.

However, Mig welding reduces total heat input since only one pass is required from each side instead of several stringer-bead passes.

Using Linde Co. equipment, National Steel mounts the 30-in. diameter 6061 aluminum cylinders on a rotary positioner beneath the welding head. Joint edges of the aluminum are square-machined for cleanliness and incorporate a ⅜-in. chamfer for minimum reinforcement.

One-pass 8-ipm welds are then made from each side at relatively low current (400 amp) and 27 volts d-c reverse polarity, using 3/32-in.-diameter aluminum wire. Argon shielding flow is 100 cfh.



MIG square-butt welded joints are made with single pass. Bottom weld was made using copper backing strip.

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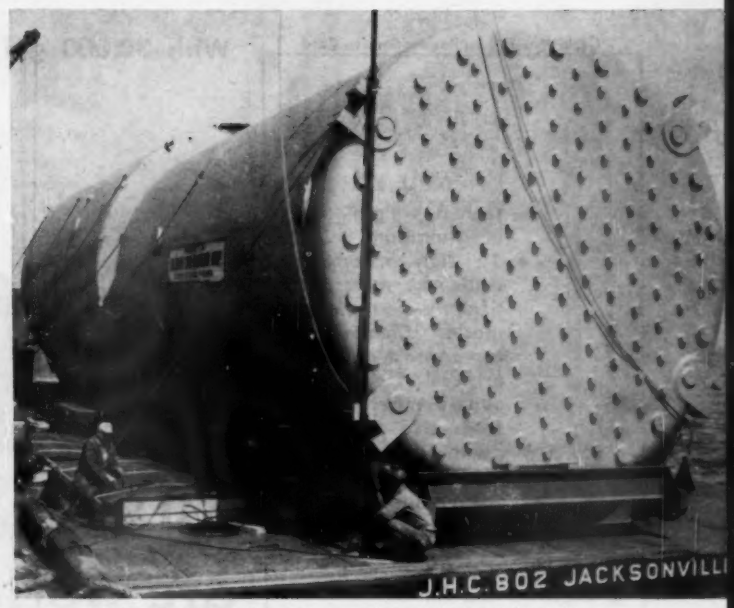
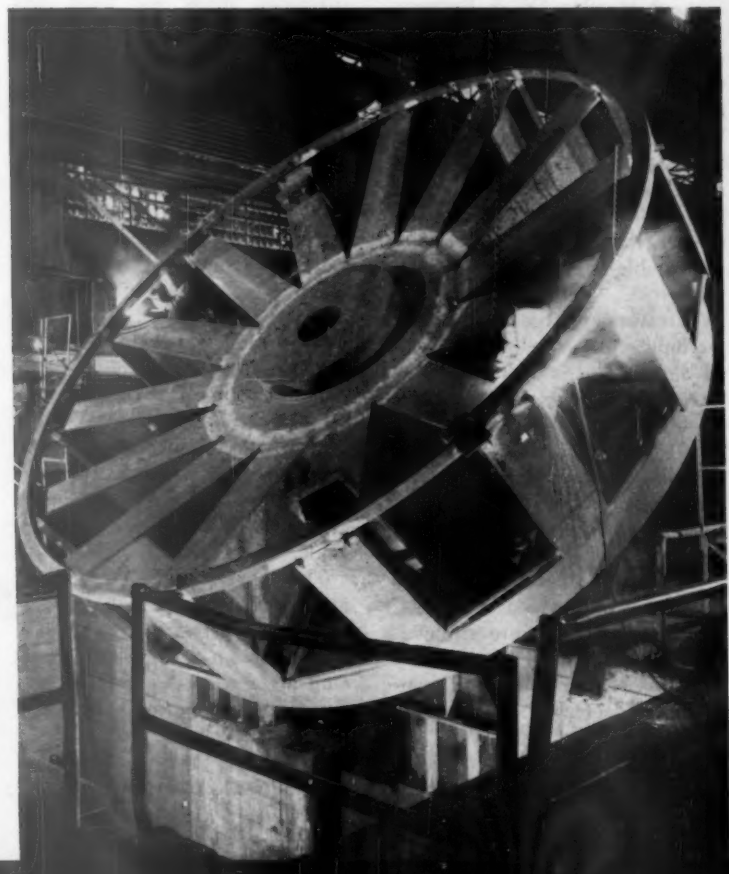
CLAMP ASSEMBLIES welded at a rate of 1,300 per hour on this dual electrode resistance welder will become part of the dialing mechanism of new telephones. The welder, manufactured by Precision Welder and Flexopress Corp., Cincinnati, is in use at Western Electric Co., Indianapolis.



GIANT WELDED-steel container sections, built by Baldwin-Lima-Hamilton, Eddystone, Pa., are secured to a barge for waterway shipment to Hallam, Neb., where they will become part of a sodium-cooled reactor for Atomics International, a division of North American Aviation, Inc.

On the job...



THIRTY-TWO TON Spiders for the first of two generators supplied by Allis-Chalmers Mfg. Co., Milwaukee, for Bull Shoals Dam in Arkansas, are welded before installation.

TIG TORCH, made by Linde Co., New York City, is used to weld a broken aluminum spring hanger. Bell Lines, Inc., Charleston, W. Va., saved $3,000 by welding damaged truck parts which they had accumulated.

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A DOZEN ALL-WELDED railroad tank cars, with the largest capacity in the world, are now in use.

Produced by Union Tank Car Co, Chicago, with tank shells fabricated at their Graver Tank & Mfg. Co. division at East Chicago, Ind., these Hot Dog – 30 cars have a 30,000 gal capacity.

The cars are being leased to carry ethyl ether by the Baton Rouge refinery of Esso Standard, Div. of Humble Oil & Refinery.

Employing a patented "hot dog" design (*WE*, March 1960, page 64, *Giant railroad tank car has 21,700 gal capacity*), these 85-ft-long cars weigh less, carry more, have greater versatility and are safer and more efficient to operate, maintain, load, unload and inspect than other tank cars of comparable size – thanks to welding.

These newest large capacity cars are built with a steel cradle welded directly to the tank and keyed to the underframe as a substitute for the usual tank bands.

Tank band elimination and incorporation of welded construction have brought car weights down 8 to 12%. Tests by the Association of American Railroads also show that welded "hot dogs" without tank bands are stronger.

Since the principal cost of a new tank car is in material and components, decreased weight has meant lower cost.

In addition, a larger total gallonage capacity is available.

This is partly because the reduction of weight in construction allows additional weight in capacity, but it is also a result of elimination of the underframe and the dome.

In place of the conventional dome, which requires cutting an opening in the tank shell of 29 in. in diameter or more in an area of maximum stress, the giant cars maintain full strength of the tank by having only an 18-in. manway opening.

Manual metal-arc welding using 3/16, 7/32, and ¼-in.-diameter E7018 electrodes joined all structural sections.

Submerged-arc welding, using carbon-molybdenum steel wire 5/32 in. in diameter, joined the shell sections.

Steel used was A212, grade B, 25/32-in. thick.

Power source was a 1,200 amp d-c motor generator. Welding speed, with 1.1 lb per ft of weld metal deposited, was 12 ipm. All edges were double beveled with ¼-in. land and 90 deg included angle.

Three passes were required to join shell sections. Current settings for the two passes on the first side were 600 amp at 31 volts and 850 amp at 36 volts. Current settings for the second side were 1,050 amp at 36 volts.

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Yes—it can easily be extended with larger or smaller size tips and nozzles—or multi-flame nozzles if required. Contact your nearest authorized National of ... california dealer or write directly to the factory for additional information.

50 National of ... california

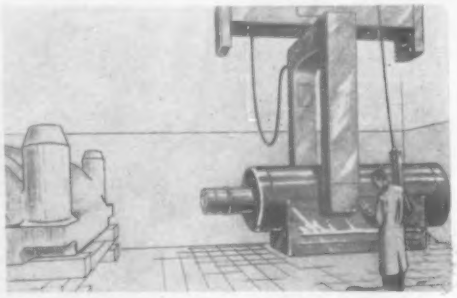
should your operations call for a lighter outfit may we recommend the popular NATIONAL FIVE STAR CADET PAK $89.50

561

NATIONAL welding equipment company... 218 fremont street san francisco 5 california

IN SUMMARY . . .

All-State Welding Alloys Co., Inc., White Plains, N. Y., is now packaging its welding, brazing and soldering fluxes in unbreakable plastic jars in ¼, ½ and 1-lb sizes . . . **General Plastics Corp.,** Bloomfield, N. J., has added Rokide ceramic spray coating developed by **Norton Co.,** Worcester, Mass., to its coating service . . .



The world's most powerful X-ray machine designed for high-speed radiography in the metals industry (see cut) will be installed at the **A. O. Smith Corp.** Milwaukee plant next spring. **High Voltage Engineering Corp.,** Burlington, Mass., is building the unit . . . **L. C. Miller Co.,** Los Angeles, has moved into new facilities in Monterey Park, Calif. . . .

Jackson Welding Supply Co., Inc., Jackson, Mich., a distributor for **Air Reduction Sales Co.,** has opened a new liquid storage and conversion station. Airco has also issued a 16mm film, in color and sound, on industrial gases and shielded arc-welding. Another change at Airco is the introduction of new cartons to minimize moisture absorption in low-hydrogen electrodes . . .

Roy Franz, welding engineer, **Graver Tank & Mfg. Co.,** East Chicago, Ind., presented a paper on shop-fabricated aluminum pressure vessels and field-erected storage tanks at the recent meeting of the Chicago section of AWS . . . **Posen & Kline Tube Co.,** Norristown, Pa., a **Handy & Harman** subsidiary, has opened a midwest branch office at 1900 W. Kinzie St., Chicago . . .

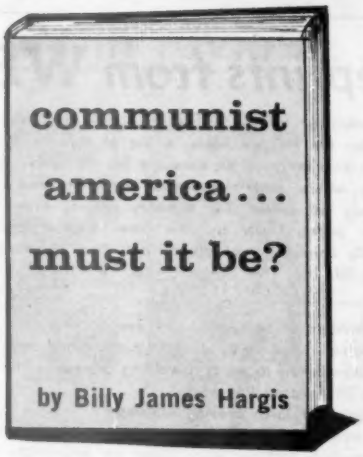
As part of **Pheonix-Rheinrohr Corp.'s** program to train students and technicians from under-developed countries in Asia and Africa, a group of Indian students are being trained at the firm's Duesseldorf plant in West Germany (see cut) . . . **Selas Corp. of America,** Dresher, Pa., has moved its Cleveland sales district office to 6025 Mayfield Rd. . . .

National Cylinder Gas Div., Chicago, has new transfilling plants to provide local customers with oxygen. The plants are at 3091 Market St., San Diego; 366 W. 5th St., Salt Lake City; and 24th and North Santa Fe Sts., Pueblo, Colo. NCG has also dedicated a new plumbing and pipe fitting apprentice training center at Norfolk, Va. . . .

Tube Turns Div., Chemetron Corp., Louisville, has established a district office in St. Paul . . . **Armco Steel Corp.** plans to build the world's most modern combination pipe mill at the Ambridge, Pa., plant of **The National Supply Co.,** an Armco subsidiary . . . American managers of **The Gevaert Co. of America, Inc.,** New York City, recently completed a sales meeting at the firm's plant in Mortsel near Antwerp, Belgium . . .

A new technical service to deal with nickel alloys at elevated temperatures has been established by the Development and Research Div., **International Nickel Co., Inc.,** New York City . . . **National Electric Welding Machines Co.,** Bay City, Mich., sponsored a special program on new product management at the November RWMA meeting . . .

NOW AVAILABLE TO READERS OF WELDING ENGINEER!



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only $1

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WELDING ENGINEER
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of this startling new book is Dr. Billy James Hargis, founder-director of Christian Crusade, largest anti-Communist organization in America . . . publisher of a monthly magazine . . . author of weekly newspaper column . . . heard daily on radio stations throughout the Nation . . .originator of Bible Balloon project . . . authority for charges of Communist infiltration into certain church-related groups as revealed in Air Force Manual controversy.

Read the accurate FACTS on the threat of the Communist conspiracy *to* America and in America . . . 15 fully documented chapters, 185 pages of TRUTH about the Red menace to America's press, schools, labor unions, racial tensions, courts, international relations, churches. *13,000 copies sold in first 90 days!*

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For a limited time, Christian Crusade offers the following booklets, written by Billy James Hargis, regularly selling for 25¢ to 50¢, for the **BARGAIN RATE of 10¢ each** (minimum order — $1)

USE THIS HANDY ORDER FORM

- ☐ Communism and the American Farmer
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- ☐ The Communist Blueprint to Rule America
- ☐ United Nations — A Confidential Report
- ☐ The Implications of Mental Health Legislation
- ☐ Apostate Clergymen Battle For God-Hating Communist China
- ☐ The National Council of Churches Indicts Itself
- ☐ Communism And You
- ☐ The Truth About Segregation
- ☐ 1313 — Cathedral Of Progress or Citadel Of Treason?
- ☐ National Council of Churches and Racial Agitation
- ☐ Reds Are After Our Panama Canal
- ☐ Clippings of Air Force Manual Controversy
- ☐ Apathy of Americans — Powerful Communist Weapon
- ☐ Your Dwindling Dollar
- ☐ No Room In The Inn Or In The U.N.
- ☐ Integration By Force Is Not A Christian Crusade
- ☐ Cuba — New Communist Satellite?
- ☐ Creeping Socialism Via Urban Renewal
- ☐ Should We Finance Communist Dictators Like Sukarno?
- ☐ Metropolitan Nicolai — Communism's Tool to Undermine American Churches
- ☐ Little Known Facts About History's Greatest Event — Christ's Resurrection
- ☐ Mr. Businessman — You Are Their Target
- ☐ The National Council of Churches Aids and Abets Communism
- ☐ American Youth Revolt in San Francisco
- ☐ Your Enemy Means Business
- ☐ Congressional Hearings: Air Reserve Center Training Manual
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This offer good while these booklets last!

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Please send me_____copies of "COMMUNIST AMERICA — MUST IT BE?" at $1 each.

Please send me those booklets checked above (minimum order, $1) at 10 cents each.

Enclosed is my check, cash, money order for $_____.

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WELD FLAWLESSLY and PERFECTLY because with TEC...

- **YOU SAVE on GAS!:** Engineered to expand gas volume and control turbulence for a uniform gas flow.
- **YOU SAVE in PARTS!:** No stock of spare parts necessary. Unit construction in all models.
- **YOU SAVE in TIME!:** See what you weld. Nozzles for every situation.
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TEC — MANUFACTURERS OF VISUWELD EQUIPMENT
TEC TORCH CO., INC.
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Reprints from WE

Reprints of certain articles published in Welding Engineer are still available. A list of these appears below. Reprints may be obtained for 15 cents each, except where otherwise noted. Payment must accompany all orders. For quantity orders, write for special prices. Order by title from: Reprint Editor, Welding Engineer Publications, Inc., Box 28, Morton Grove, Ill.

Fundamentals of wear resistant overlay
Explains causes of metal deterioration and how to avoid it and how to select a welding process for hardfacing. This reprint 25¢ each.

Techniques for torch brazing aluminum
Procedures and techniques for brazing aluminum, are detailed. Includes data sheet on brazability of aluminun alloys plus four tables listing commercial products and their characteristics. This reprint is free.

Design for welding
Basic knowledge required when designing, or redesigning for welded construction is detailed and discussed. Sixteen page reprint includes 11 data sheets.

The meaning of weldability
Weldability of carbon steels and alloy steels, as well as some other metals, is discussed. Sixteen page reprint includes three data sheets.

Tungsten inert gas
A 16 page report on the history, theory and application of the Tig welding process. Includes data sheet on proper current selection. This reprint is free.

Welding of dissimilar metals
Complete details on welding dissimilar metals using NiCrFe electrodes and wires. Eight page reprint includes charts on properties, test results and data sheet on properties of other metals.

Acetylene
A 12 page salute to the IAA and acetylene, details the great success of this gas. Includes a history of the IAA and "The Acetylene Journal."

Fixtures for brazing
Presents requirements for designing brazing fixtures and materials to be used. Data sheet on properties of non-metallic fixture materials included. Free.

Selection, welding of CrMo alloy steel pipe
Discusses determining factors in selection of chromium-molybdenum alloy steels and evaluates the effects of pre- and postheat treatment on weld properties.

Filler metals for joining
Brazing filler metals are detailed and each group is analyzed. Includes data sheet on how to select silver brazing alloys.

Production welding controls
Discusses how material, labor and overhead effect total production welding costs, and how certain controls can result in greater time and dollar savings. This reprint is free.

New aluminum alloy not prone to brittle fracture
Extensive testing of 5083 aluminum alloy proves it has excellent weldability and weld ductility, and a good resistance to corrosion and stress corrosion. Testing for brittleness is detailed. This reprint free.

Explosive welding and forming open another door
A report on one of the newest entries into the welding industry, and how one pioneer company turned theories and practices into realities.

Our modern-day mythology
A rebuttal to some old-wives tales about the hazards of welding fumes, plus safety recommendations for situations where hazards might develop.

Understanding weld distortion and shrinkage
Causes of distortion and shrinkage can be determined if weld heat is understood. Eleven drawings are used to illustrate this welding problem.

VIPs in review . . .

Webb

Shephard

At Haynes Stellite Co., New York City, *Charles G. Chisolm* has been appointed vice-president of marketing and *H. C. Webb* has been appointed central district sales manager. *F. P. Shephard,* district sales manager of this area for the past 25 years, is planning to retire.

American Manganese Steel Div. of American Brake Shoe Co., New York City, has named *H. Brown Reinhardt* eastern sales manager. He succeeds *E. J. Nist,* who has reached retirement age. Nist will continue to represent the firm in the Southeast.

Douglas L. Heisler has been named director of purchasing for Vickers Inc., Div. of Sperry Rand Corp., Detroit. Prior to joining Vickers, Heisler was corporate procurement manager of the Whirlpool Corp.

Richard K. Brown has been elected president of National Welding Equipment Co., San Francisco. He succeeds *Ernest L. Mathy* who has retired. Mathy will continue in an advisory capacity.

Brown

Beckstrand

Birdsell Div., Susquehanna Sciences, Inc., has appointed *R. Gail Beckstrand* sales manager. Beckstrand was formerly sales manager of Anderson Equipment Co., Los Angeles. Birdsell, Palo Alto, Cal., recently acquired by Susquehanna, manufactures a complete line of welding machines.

Amperex Electronic Corp., Hicksville, L. I., N Y., has promoted *Tom O'Connor* to distributor sales specialist. O'Connor was formerly manager of the sales order department.

Austin J. Paddock has been named administrative vice president of fabrication and manufacture for United States Steel Corp. He will be in charge of the American Bridge Div., Consolidated Western Steel Div., Universal Atlas Cement Div., and United States Steel Homes Div.

Delbridge

Mears

Walberg

Casick

In changes at Metal & Thermit Corp., New York City, *Chester F. Delbridge* has been named product manager of welding equipment and accessories; *Harold W. Mears* has been appointed northeastern states regional sales manager, Welding Products Div.; *George M. Walberg* has joined M&T as welding machine specialist and will be headquartered in Rahway, N. J.; and *Robert E. Casick* has been appointed welding sales engineer. He will provide technical assistance and service in Wisconsin and northwestern Michigan.

William R. Schneider, author of a WE article in the September 1960 issue (*Quality control is a must when welding radar antennas*), has been named head of the commercial welded products department of D. S. Kennedy & Co., Cohasset, Mass. Schneider joined the firm as chief welding engineer in 1959.

NEW! WYPO FILE FREE!

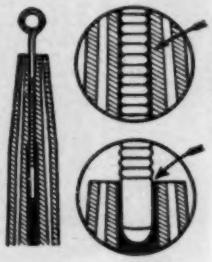
NEW POLISHED ALUMINUM CASE DESIGNED TO SERVE AS HANDLE FOR THE NEW FILE

Let Your Local Welding Supply Dealer Explain Why "YOU GET SO MUCH MORE" With . . .

WYPO
Wipes and Polishes *the World's Finest* CUTTING & WELDING TIP CLEANERS

FREE! NEW, SPECIALLY DESIGNED WYPO POLISHING FILE INCLUDED IN EACH SET

More Exclusive WYPO Features



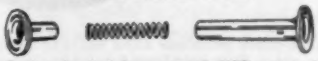
These rounded outer edges of cleaning ridges clean and polish tip orifice without scratching or cutting.

This smooth pilot guides WYPO Tip Cleaner into tip. Will not enlarge or damage tip port.

This cross section view of WYPO Cleaning Surfaces shows these exclusive features: Rounded cleaning surfaces that won't jam or cut.

Straight sided valleys insure thorough cleaning by removing all waste.

SPRING LOADED SPOOL



Spring loaded brass spool. Will not rust. Holds cleaners securely in case.

DOUBLE WOUND EYES

Insures longer life for small sizes of WYPO Tip Cleaners. Will not pull out of case.

STAINLESS STEEL POLISHING FILE

Specially designed WYPO File furnished free in each set

NOW AVAILABLE IN 3 CONVENIENT SETS

WYPO TIP CLEANERS
STANDARD SET

CLEANER NO.	FOR DRILL
7	75-74
8	73-72-71
10	70-69-68
12	67-66-65
14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49

5 S WYPO FILE
MADE IN U.S.A.
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IN CANADA 1960

STANDARD SET OF (12) Cleans (27) Drill Sizes Nos. 75 to 49 Incl.

WYPO TIP CLEANERS
JUMBO SET

CLEANER NO.	FOR DRILL
28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
45	30

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IN CANADA 1960

JUMBO SET OF (9) Cleans (19) Drill Sizes Nos. 48 to 30 Incl.

MASTER SET

CLEANER NO.	FOR DRILL
7	75-74
8	73-72-71
10	70-69-68
12	67-66-65
14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49
28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
45	30

WYPO TIP CLEANERS
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IN CANADA 1960
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MADE IN U.S.A.

MASTER SET OF (31) Cleans (46) Drill Sizes Nos. 75 to 30 Incl.

Replacement cleaners and files available. Cleaning Range— Cleaner No. & Drill Nos. stamped on back of each case. WYPO GIVES YOU MORE!

SOLD BY LEADING WELDING SUPPLY DEALERS

MAITLEN AND BENSON, INC.
1395 Obispo St., Long Beach 4, Calif.

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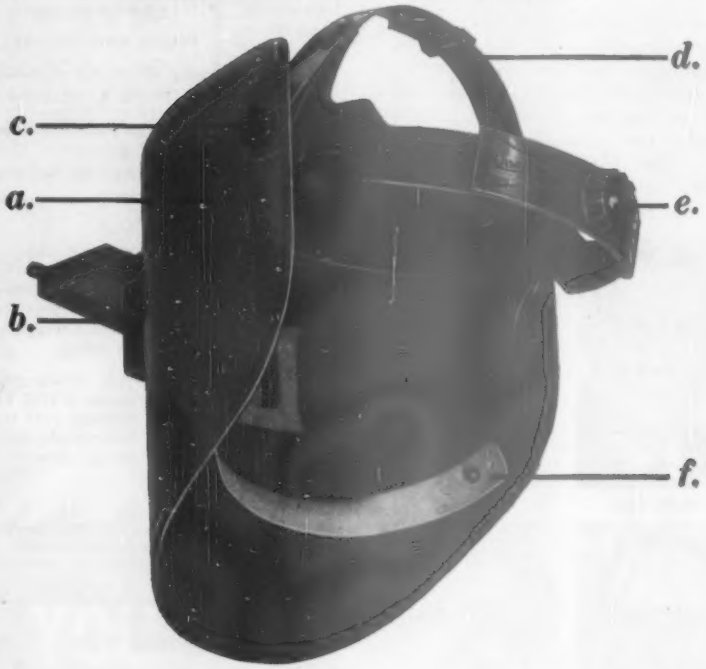
Next time you pick up your helmet...see if it gives you all the advantages of this **OXWELD** helmet



a. *One-piece seamless shell* molded from tough glass-fiber-reinforced polyester resin—lightweight, easily cleaned, strong, non-warping.

b. *Flip-front glassholder* die-cast from aluminum, stationary glassholder molded as integral part of shell for a light-tight seal.

c. *Fingertip tension adjustment* to hold helmet in up or down position. "CP" joints of durable plastic will not pass electric current.

d. *Adjustable crown strap* holds helmet firmly in choice of five positions.

e. *Rear knob* instantly adjusts headband size over wide range without need for removing helmet.

f. *Adjustable fiber chin rest* assures proper visual alignment and maximum comfort.

Compare these advantages with those offered by any other helmet. There are eight different types of OXWELD helmets and handshields. And each is designed with every advanced feature for maximum protection against infra-red and ultra-violet rays, sparks, and molten metal.

Comfort is a big factor. OXWELD helmets have been given the careful detailing that provides easy, instant adjustment, snug fit, and the "free-floating" suspension that eliminates pressure points. You can choose from three sturdy shell styles.

See them at your LINDE distributor's. Or write for literature and price lists. Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. *In Canada,* Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

LINDE COMPANY

UNION CARBIDE

"Linde", "Oxweld", and "Union Carbide" are registered trade marks of Union Carbide Corporation.

L. A. Patt has been elected chairman of the board of the Grinding Wheel Institute for 1961. Other officers elected are *W. G. Pinkstone,* president, and *C. F. Leitten,* vice president.

Patt

Hill

In a major sales realignment in the Welding Products Division, A. O. Smith Corp., Milwaukee, has named *Arthur Hill* sales engineer in Cleveland. *Vernon H. Hartley* moves into Hill's former position in the Louisville sales office. In addition, *Richard F. Sanford* has joined A. O. Smith's sales office in Detroit.

Drs. *George E. Hudson* and *R. M. G. Boucher* of New York University have been named consultants to International Ultrasonics, Inc., Rahway, N. J. They were also elected to the firm's board of directors.

A. D. R. Fraser, president of Rome Cable Div., Aluminum Co. of America, has been elected president of the National Electrical Manufacturers Association. He succeeds *N. J. MacDonald. W. R. Persons,* president of The Emerson Electric Mfg. Co., St. Louis, was elected vice president of NEMA. Persons was also elected to the Association's board of governors.

Blodget

Spoor

Air Reduction Sales Co., New York City, has appointed *A. S. Blodget, Jr.,* midwestern regional vice president. Blodget replaces *D. D. Spoor* who is retiring. *Van Dorn Bowling, Jr.,* has been appointed assistant manager of distributor sales for the firm's Houston district.

A nine-region field organization to strengthen nationwide marketing capabilities has been announced by Tube Turns Div., Chemetron Corp., Louisville. Headquarter cities and new regional managers are: *S. M. Hardison*, Atlantic region, New York City; *Herbert P. Smith*, North Central region, Pittsburgh; *J. C. Ellsworth*, Northern region, Chicago; *James F. Craig, Jr.*, Southeastern region, Atlanta; *E. R. Muir, Jr.*, Central region, Louisville; *L. D. Hall*, Midwestern region, Kansas City; *L. O. Morris, Jr.*, Mid-continent region, Tulsa; *W. B. Whenthoff*, Southwestern region, Houston; and *N. P. Bosemer*, Pacific region, Los Angeles.

Chicago Bridge & Iron Co., Chicago, has appointed *William M. Freeman* as sales manager in the New York district. Freeman assumes his new position after two years as manager of CB&I's process equipment sales group.

Mine Safety Appliances Co., Pittsburgh, has appointed *Richard E. Miller* product line manager for eye and face protection equipment. Miller will supervise sales of the firm's new Sightgard line.

General Electric Co. has appointed *Frank W. Green* to the Resistance Welding Engineering Section, Detroit. Green will be active in the control engineering and development group.

John H. Simonds has been elected chairman of the board of directors of the Abrasive Grain Association, Cleveland.

Simonds

Bernard

Omark Industries, Portland, Ore., has named *W. H. "Barney" Bernard* assistant engineer of the welding division. Working out of Cincinnati, Bernard will be concerned with product development in the stud welding field. Omark has also named *Cecil Baltzegar* supervisor of European marketing. He will supervise the firm's marketing in Europe concentrating his initial activities in Scandinavia, the United Kingdom and Germany.

In a move to step-up the development of new products and to expand engineering services and sales, United Welding Co., Middletown, Ohio, has added an engineering sales department to be managed by *Frederick P. Menzel.*

Air Reduction Co., Inc., New York City, has named *G. R. Milne* president of the firm's new division, Air Reduction Chemical and Carbide Co., which includes all Airco chemical companies. Other officers of the new division are *B. R. Krashin*, vice president of marketing; *R. T. Lund*, vice president of operating; *R .A. Speck*, vice president of distribution; *J. M. Tinnon*, vice president of engineering; and *F. E. Evers*, controller.

James N. Landis, vice president of Bechtel Corp., San Francisco, has been elected president of Engineers Joint Council, New York City. He succeeds *Augustus B. Kinzel*, a vice president of Union Carbide.

Albert F. Lange has been appointed New York district sales manager for Penco Div., Alan Wood Steel Co., Oaks, Pa. He was formerly New England district manager for the steel storage equipment firm.

Joseph W. Antonides has been appointed chief of engineering services, and *Carl A. Steinhagen* has been appointed chief of engineering planning at Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

Robert T. Cavanagh has been appointed general manager of Philips Electronic Instruments, Div. of Philips Electronic & Pharmaceutical Industries Corp., Mount Vernon, N.Y. Cavanagh joined Philips early this year as assistant general manager.

John K. Bybee has been named an agent in the Southeastern United States for Ampco Metal, Inc., Milwaukee. Bybee has been associated with the firm since 1939.

National Cylinder Gas Div. of Chemetron Corp., Chicago, has appointed *Milo B. Prisuta* as supervisor of the technical service section of the research and development department. Prisuta was formerly in charge of product development in the Nuclear Reactor Division of Westinghouse Electric.

SPECIALIST-

your
LINDE distributor

It takes more than a line of welding equipment to be a LINDE distributor. It takes real knowledge of your welding needs . . . knowledge of local industry . . . practical experience and interest in efficient welding operations . . .

These are some of the qualifications that make your LINDE distributor so valuable to your business. He's a specialist in his field, equipped with a complete stock of welding and cutting equipment, industrial gases, welding rods, supplies, and accessories. They're all products of highest quality and proved efficiency. Your LINDE distributor is ready to help you today, with equipment, expert advice, and the benefits of LINDE's 50-odd years of welding and cutting leadership.

A telephone call will prove the point. Look up your LINDE distributor in the classified directory. Or write to Linde Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada*, Union Carbide Canada Limited, Linde Gases Division, Toronto 12.

LINDE COMPANY

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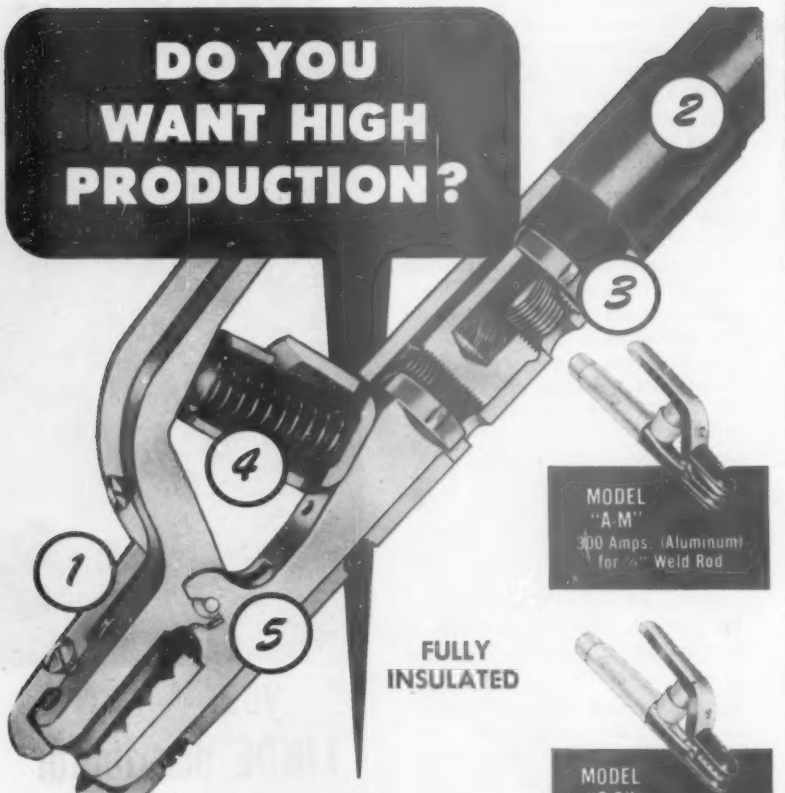
DO YOU WANT HIGH PRODUCTION?



FULLY INSULATED

MODEL "A-M" 300 Amps. (Aluminum) for ⅛" Weld Rod

MODEL "C-S" 250 Amps. (Copper Alloy) for 3/32" Weld Rod

MODEL "C-M" 300 Amps. (Copper Alloy) for ⅛" Weld Rod

MODEL "C-L" 500 Amps. (Copper Alloy) for 5/32" Weld Rod

SuperGrip™

PRODUCES

more work, safer, easier!

SuperGrip Electrode Holders are designed to make easy all operations in welding...from attaching Holder to cable on through to depositing weld metal in any welding position!

YOU GET MORE out of *Super-Grip* for these reasons:

1 RUGGED, LONG WEARING interchangeable jaw insulators are easily replaced *QUICKLY*. Jaw pads of the aluminum Model "A-M" are easily replaced.

2 EXCLUSIVE NECKED-DOWN HANDLE cuts "cable fatigue" and "down time" by reducing cable play at handle end and close to cable connection...prevents fraying and fatigue of wire strands... makes *SuperGrip* firmer, handier working tool.

3 BALL POINT SET SCREW of "man-size" diameter really *grips* cable tightly...can be tightened without removing handle...provides maximum current-conducting cross section...minimizes re-connections to save time.

4 POWERFUL COMPRESSION of enclosed spring puts extra "bite" in *SuperGrip* jaws...minimizes electrode waste or loss.

5 PERMANENT PIVOT BUSHING in tongue of trigger assures alignment, minimizes wear and increases service life of the Model "A-M" Aluminum Holder. Positive grip helps produce more... better work.

Get our Bulletin No. 65 or...
Ask your Welding Distributor!

The FIBRE-METAL Products Company | CHESTER PENNA.

In CANADA: Fibre-Metal (Canada) Limited, Toronto

Ernest J. Florestano has been named district manager in the maritime area of Virginia by Eutectic Welding Alloys Corp., Flushing, N. Y. Florestano was previously senior technical representative in the area.

D. F. Bovie has been named assistant manager, engineering services, Pittsburgh district for Air Reduction Sales Co., New York City. Bovie will be responsible for the demonstration, installation and maintenance of the company's products.

Square D Co., Chicago, has appointed *Ray W. Thompson* to the position of general sales manager, marketing division. Thompson will spend most of his time in field contact, acting as liaison between headquarters and sales regions.

George E. Parker has been appointed assistant sales manager of Cincinnati Milling Products Div., The Cincinnati Milling Machine Co. He joined the firm in 1940 and has been district sales manager in the division's Chicago office.

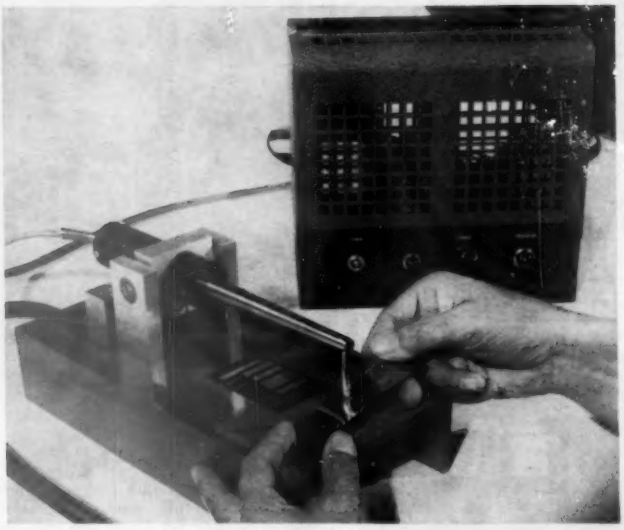
Robert W. Anderson has been appointed New England district sales manager of Arcos Corp., Philadelphia. He will handle the firm's line of welding rods and wire, wire feed units, electrodes, fluxes and accessories.

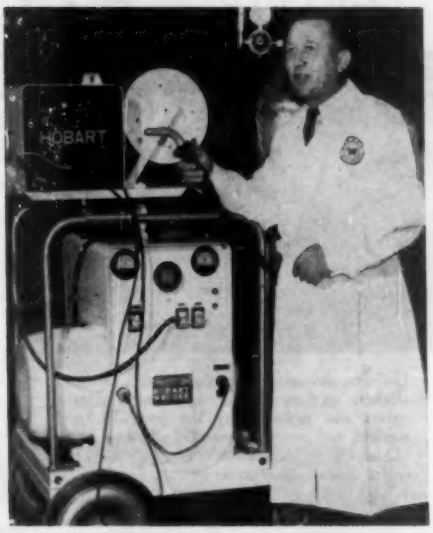
Died. . .

Thomas McElrath, Jr., 41, special project engineer for the Linde Co., Electric Welding Development Dept., Newark, died on November 6. Mr. McElrath joined Linde in 1941 after graduation from Massachusetts Institute of Technology with degrees of Bachelor and Master of Science in Mechanical Engineering.

L. F. Vonier, veteran welding executive for A. O. Smith Corp., Milwaukee, died recently in Milwaukee. Mr. Vonier joined the firm's welded products division as general sales manager in 1937. In recent years he was a divisional sales consultant.

New products . . . . . use card on page 103

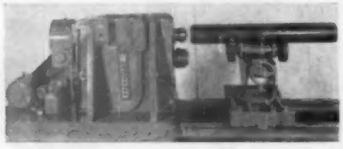




Ultrasonic foil welder

Ten-watt ultrasonic foil welder can spot weld foil in thicknesses ranging from 0.00025 to .002 in. Using high frequency vibrations to weld without heat or without materially deforming the metal, the new product produces welds as strong or stronger than parent material. Hermetic seals are also provided. Welding applications include joining gold leads to gold plated semiconductor material and gold, silver and aluminum leads to germanium, silicon and ferrite. *Gulton Industries, Inc.*

Circle No. 1



Pipe offsetter

Model M2-P pipe offsetter will handle pipe 6 in. to 30 in. in diameter and .28-in. thick. Unit has five material settings and rolling speed of 24 fpm. Roll motor is 5 hp and hydraulic adjusting motor is 1 hp. Approximate shipping weight is 3,100 lb. *The Webb Corp.*

Circle No. 2

Air-cooled triode

Air-cooled triode with 2,100 watt plate dissipation rating is designed for use as an oscillator at frequencies up to 50 mc in induction heating applications. Type 7753 triode features radiator design and special cathode with high peak emission permitting intermittent overload without damage to cathode. *Amperex Electronic Corp.*

Circle No. 3

Surfacing process

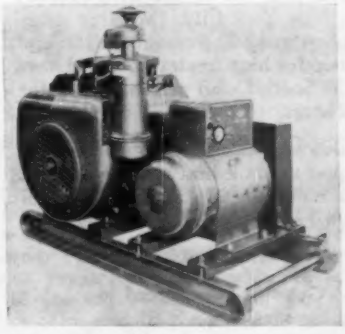
Metal-to-metal surfacing process uses standard oxyacetylene welding outfit with modified torch tip permitting powdered metals to be sprayed through the flame. Supplying smooth, steady controlled supply of powdered metal to base metal, the process is useful in fabricating metal office furniture and sanitary joints for hospital furniture. Process can also be used for metal spraying alone and spraying subsequent to fusing. Gas carrier source dispenses and carries metals to torch tip with flow of about 5 to 8 cfh. Process permits depositions down to .003-in. thick. *Air Reduction Sales Co.*

Circle No. 4

Repair material kit

Kit contains three-ounce tubes of metal-joining material and hardening agent. To make repairs, equal lengths of each material are squeezed from tubes, mixed with wooden paddle (included in kit), and applied to part or casting to be repaired. Mixture contains approximately 80% aluminum and 20% improved epoxy resins and modifiers. Material will not shrink and will adhere to steel, iron, aluminum, bronze, glass and many other surfaces. *Devcon Corp.*

Circle No. 5



Power-engine generators

Power-engine generators are rated at 12,000 watts a-c and are equipped for remote starting. Powered by a Wisconsin VH4D air-cooled gas engine, the generators will carry a 5-hp motor plus 6,000 watts of simultaneous resistive load. *Wincharger Corp.*

Circle No. 6

Automatic welder

Constant voltage motor-generator welder, rated 200 amp at 25 volts, is designed for automatic welding. Unit makes possible firm's Micro-wire welding, a low-amp electric-arc process which continuously feeds a small-diameter bare wire electrode into welding zone shielded by gas (usually CO^2). Model 1259 unit includes welder with ammeter and voltmeter, wire feed unit, Micro gun and cable assembly, gas regulator and flowmeter with hose and argon adapter fitting, all on portable mounting with space for carrying two gas cylinders. *Hobart Bros. Co.*

Circle No. 7

Portable welding guns

C-Type portable welding gun (above) is one of new line designed for compactness. Line includes scissors-, bell-crank, expansion-, and fixture-type units. Features include extra-long main shaft bushing, shunt contact arrangement utilizing full current-carrying capacity of the copper to keep operating temperatures down. *Kirkhof Mfg. Corp.*

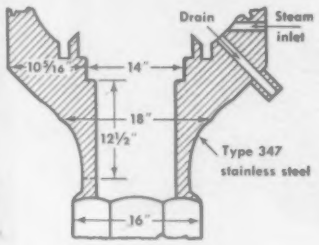
Circle No. 8

X-ray unit

X-ray unit for testing and inspection has tube with 0.012-in. focal spot for sharper pictures. Unit has rotating anode tube with continuous rating of 6 milliamperes at 150 kv. Counter-weighted 3-in.-square mast eliminates vibration. Mast can be pivoted 360 deg and fits under an 8-ft-high ceiling. Telescoping tube arm provides 16-in. cross-travel. *Picker X-Ray Corp.*

Circle No. 9

Profit through E.A.I. Research



Uniform, through-and-through heating of the thickest sections of the big stainless steel valves was provided by the Smith-Dolan method, with precision control of temperatures (2-hour dwell at 1900°F.). Drawing shows cross-sectional dimensions.

Standard Smith-Dolan units come equipped with eye hooks and wheels for easy portability, and with instrumentation for recording permanent charts of the heat run.

SMITH-DOLAN On-the-Job HEAT TREATMENT

Solution to Weld Embrittlement Problem at Consolidated Edison

Public utilities are among the largest users of the Smith-Dolan System of Low-Frequency Induction Heating. They want to keep their service uninterrupted, their costs low, and they find that this portable system simplifies the problem of pre-heating and post-annealing in producing sound welds, and in making dependable repairs.

A typical application of the system by a public utility was described in a recent article in Welding Design & Fabrication.* At Consolidated Edison's No. 10 Turbine Generating Station in New York City, two large steam pressure valves made of Type 347 stainless had to be repaired because of weld embrittlement. Removal to the shop for heat treatment would have proved costly and time taking. With the Smith-Dolan portable units, the work was completed on the job within 12 hours.

Learn about the savings and other benefits your company can obtain from the Smith-Dolan System. It is today's most versatile heat treating method, simplifies and upgrades work quality in numerous applications. Write for brochure, "Smith-Dolan System of Low-Frequency Induction Heating."

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Electric Tig welder

Electric Tig welder features compact design, simplified operation and low cost. Designed for 13 to 295-amp welding range, a-c unit features fully rated duty cycles of 40% at 200 amp or 30% at 295 amp. Other features are electrically-controlled gas and water valves, high frequency intensity control, direct or remote operation, and post flow control and pilot light. *The Emerson Electric Mfg. Co.*

Circle No. 10

Miniature grinding wheel

Miniature flexible grinding wheel is available in 2½-in. or 3-in. diameter. Wheel can be used on fixed or portable shafts at up to 15,000 rpm. Constructed of scores of thin, flexible abrasive strips, the wheel comes in variety of grits. Wheel is useful for finishing tight corners and hard-to-reach places. *Merit Products, Inc.*

Circle No. 11

Vacuum arc furnace

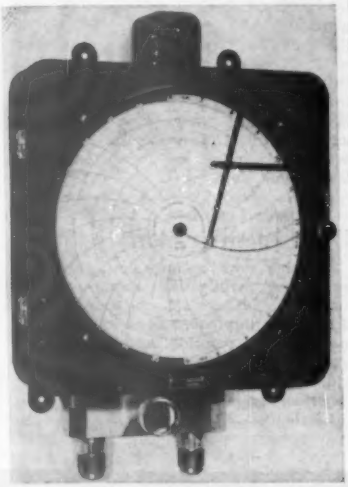
Vacuum arc furnace is designed for button melting or production of small ingots by electrode cold mold techniques. Basic unit can melt and refine up to eight 1½-in. diameter by ½-in. thick buttons of such materials as titanium, steel, zirconium and uranium. Vacuum chamber is 8-in. diameter, 10-in. high with 4-in. sight glass, 1-in. vacuum pumping port, and 6-in. charging port. Unit is adaptable to almost any laboratory melting or refining requirement. *NRC Equipment Corp.*

Circle No. 12

Transistor welder

Transistor welder, using spike power method, gives leak-tight fusion, small weld area and reduction of detrimental heat effect on sensitive minute parts. Welding power system, applied to converting 20 kva bench press welder, gave welds on odd combinations of metals in joining cap and base of transistors. Transformer accepts high voltages and achieves proper reactance values for close electrical coupling and gives necessary voltages in combination with proper capacitors. Special controls pinpoint firing of ignitron tubes for precise timing of capacitor charge and discharge on the voltage wave. *National Electric Welding Machines Co.*

Circle No. 13



Recording flow meters

Meters, designed for use with Mig, Tig (manual or automatic) record gas flow over period of 24 hours or less on easy-to-read chart. AR-100 (above) features precision metering, vane-type actuating mechanism and shock protective air cylinders. Indicator light detects leaks when flow is shut off. Model AR-400, for pipeline or regulator mounting, is 4½-in. meter and chart. AR-100 is 10-in. meter chart. *Elematic Equipment Corp.*

Circle No. 14

Ultrasonic flaw detector

Equipped with caliper attachment, ultrasonic flaw detector can measure metal and plastic thicknesses, from one side, to within ±0.010 in. Caliper consists of fixed, scribed, vertical line and second line on slider movable across cathode ray tube face. Synchronized dial indicator measures motion permitting operator to determine thickness directly without calculations or interpolation. *Branson Instruments, Inc.*

Circle No. 15

Ultrasonic cleaners

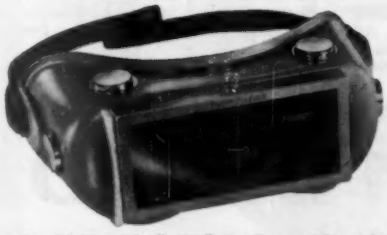
Three ultrasonic cleaners are designed to clean large volumes of precision parts at high speeds with minimum of attention. Unit 320D contains twin transducerized tanks each with a 1¼-quart capacity; 320L contains single transducerized tank with a 3¾-quart capacity. 320 has 1¼-quart transducerized tank and 1¼-quart rinse tank. *L & R Mfg. Co.*

Circle No. 16

S-42 Chippers Goggle with flat, or 6:00D Bal-SAFE lenses, clear or in Ray-Ban shades 1, 2 or 3.

W-35 Chippers Eyeshield with two Enduron 2"x4¼" plates; gives increased protection and provides air space which further reduces fogging.

S-41 Welders Goggle with Arc-Ban lenses in shades No. 3 through No. 6, with tough Enduron plastic cover lenses.



W-36 Welders Eyeshields with 2"x4¼" Arc-Ban welding plate, shades No. 3 through No. 6, with Enduron cover plate.

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Dial-control welder

Dial-control 180-amp welder can reach any amp setting desired through dial lifetime shunt control. Unit features 80 open circuit voltage for easier arc striking, Class F insulation to withstand higher temperatures without breakdown and all-steel construction with durable baked enamel finish. *Twentieth Century Mfg. Co.*

Circle No. 17

Aluminum electrode

All-position aluminum electrode with extruded flux coating is designed for d-c reverse polarity welding of aluminum sheet, plate and castings. Developing tensile strengths up to 28,000 psi, the core wire gives quiet welding and dense, spatter-free deposits and low amperage. Electrode is recommended for aluminum railings, tanks, pipe, truck and automobile construction and repairs, for build-up of missing sections, cladding and reinforcing. *All-State Welding Alloys Co.*

Circle No. 18

Temperature recorder

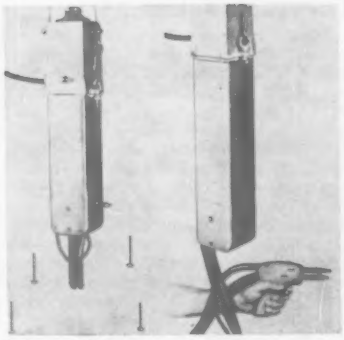
Miniaturized temperature recorder operating directly from thermocouple without signal amplification is believed by manufacturer to be first available with meter movement sensitive enough to permit temperature recording without signal amplifier. Only electrical connections necessary are the thermocouple and a 115-volt a-c line. Rear-mounted knob simplifies adjustment for thermocouple resistance eliminating need to remove resistor wire turns. Minimum temperature span covered is 0 to 500 F. Maximum span is 0 to 2,500 F. Recorder is 3⅜-in. wide, 5⅜-in. high and 4¼-in. deep. Weight with paper roll is 3¾ lb. *Assembly Products, Inc.*

Circle No. 19

Ultrasonic generator

Compact 100-watt ultrasonic generators are suited for soldering, ultrasonic welding, splicing and sealing of metals and plastics, ultrasonic cleaning, ultrasonic drilling and use with processing cylinders or other specialized transducers. Power output is continuously variable from 0 to full power. Frequency range of standard unit is 35-45 kc and impedances are 17.5 to 20,000 ohms. Ultrasonic cleaning tank is also available. *International Ultrasonics, Inc.*

Circle No. 20



Pin welder

Two units spot insulation pins to ductwork. Model PS-100 weighs 25 lb and works on 110 volts. Model PS-200, a 220-volt unit, has remote gun connected to 30-lb power source by 5-ft cables. Pins are supplied in standard lengths from 3/4 in. Pin is inserted in electrode tip. Automatic timing assures uniform, secure welds. Unit works on light and heavy galvanized and uncoated steel. *Duro Dyne Corp.*

Circle No. 21

Dark room trailer

Portable dark room trailer, designed for use as mobile dark room, is ideal for actual job site set up. Features include color impregnated fiberglass body requiring no painting and lightweight construction. Trailer is 11-ft long, 6-ft wide with 8 by 4 ft working area. *Jem Penetrameter Mfg. Corp.*

Circle No. 22

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EMERSON ELECTRIC TIG-WELD 295

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The EMERSON ELECTRIC TIG-WELD 295 has built-in high frequency . . . permits Tungsten inert gas and manual stick electrode processes to weld Cast Iron, Rimmed Steel, Carbon Steel, Stainless Steel, Alloy Steel, Nickel, Copper and Copper Alloys, Aluminum and Magnesium. It's a complete welding shop in a compact package . . . fully rated 295 amps with currents as low as 13 amps.

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- Variable gas and water afterflow
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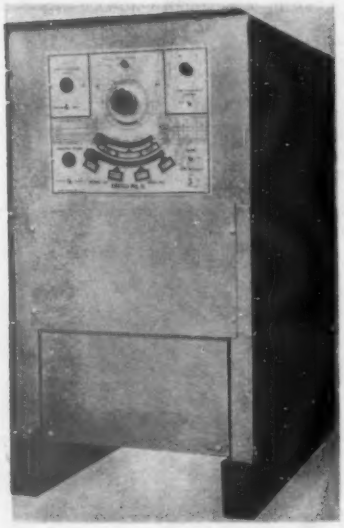

Inert-gas welder

Model 424 a-c/d-c inert-gas welder has 100% arc stability to permit welding large or fine wire weldments. Fully-resonated unit has four overlapping current ranges from ½ amp to 425 amp. Unit has linearized current adjustment to prevent deadspots and has full rating operation from 208, 230 and 460-volt lines. UL approved construction is to NEMA standards. Unit also functions as a-c/d-c metallic arc, a-c/d-c inert gas manual or automatic and d-c inert gas spot welder from precision timer. *Birdsell Div., Susquehanna Sciences, Inc.*
Circle No. 23

Nibbler attachment

Nibbler attachment permits rapid cutting of circles up to 48 in. in 11-gage steel. Twenty-four in. and 48-in. diameters can be cut with extension arms fitted to nibbler. Unit has durable rust-proof finish and can be used with firm's standard air or electric nibblers. *Fenway Machine Co.*
Circle No. 24

High visibility enclosures

High degree of visibility is obtained in laboratory enclosures for handling radioactive and other hazardous materials through 15 deg sloping fronts of safety plate glass. Enclosures feature low-intensity dry box, controlled atmosphere, microbiological safety, and stainless steel fume hoods. *S. Blickman, Inc.*
Circle No. 25

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"Long Nek" Tomahawks

IF YOU WANT THE "MOST" IN A FULL WOOD HANDLE TOMAHAWK— GET A NEW "LONG-NEK" (WH) MODEL

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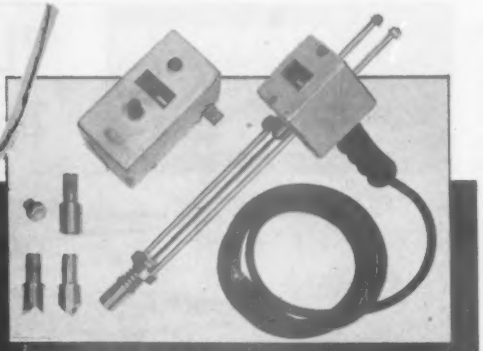

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NO arc flash . . . no arc shielding
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NO special rods

No Other Gun Like it

Here's a shock-proof, fool-proof, labor-saving welding gun for shop or assembly line that spots or welds from one side. For welder or mechanic — **the only gun that bonds stainless or dissimilar metals using stainless steel or conventional steel electrodes.** The NO-ARC gun is easy to use . . . is rugged and dependable . . welds 30-gage or heavy plate without arc flash. Operates on AC or DC.

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DUZALL . . . a new liquid flux for all soft solders, all metals (except light metals). DUZALL eliminates pre-cleaning, increases capillary action, leaves minimum deposit. Comes in handy 4 oz. refillable dispenser-type plastic containers, and in larger units.

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Send for free copy of 54-page Instruction Manual and for information on custom coating your welding rods.

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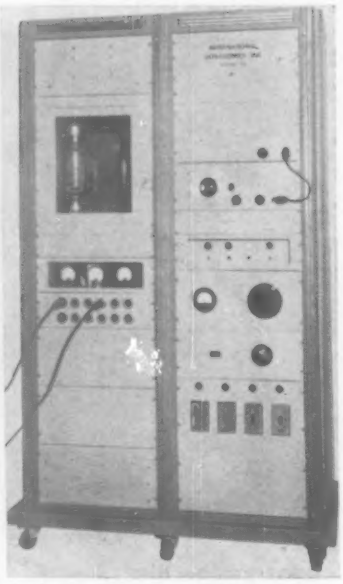


Ultrasonic generator

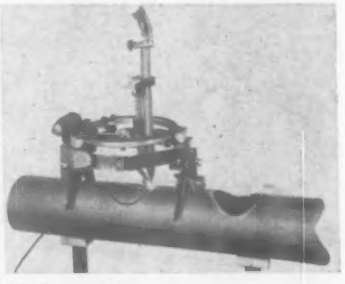
Variable-frequency 2-kw ultrasonic generator has frequency range from 1 to 100 kc with output up to 2 mc available on special order. Power output is continuously variable from 0 to 2,000 watts at frequencies from 1 to 50 kc and to 1,200 watts at up to 100 kc. Units with lower maximum power are available on special order. Standard unit has choice of 10 impedances from 3 to 200 ohms. Special transformers can be designed to meet any desired impedance requirements. *International Ultrasonics, Inc.*

Circle No. 26

Polyurethane sealant

Polyurethane sealant will not slump or sag in vertical or overhead installations even in joints as wide as 3/4 in. Applied with calking gun or knife, sealant comes in single package and requires no field mixing or curing accelerators. Sealant does not shrink on aging and will withstand temperatures of −75 to 150C. *E. I. Du Pont De Nemours & Co.*

Circle No. 27



Hole cutter

Machine cuts 90 deg holes in pipe, tanks and flat plate. Cutter comes in three sizes permitting perpendicular holes up to 18 in. in diameter without cams, patterns or layouts. Lightweight machine can be used with electric drive or may be hand operated in field. *Steffan Mfg. Corp.*

Circle No. 28

Welding goggles

Gas welding goggles for use in gas welding, cutting, burning and furnace operations are available in two styles: for wear over spectacles or wear without spectacles. Both have ventilated side-shields designed to provide ventilation and prevent lens fogging. Eye cups are individually shaped with contoured surfaces for greater safety and comfort. Both goggles available with shade No. 5 lenses only. *Air Reduction Sales Co.*

Circle No. 55

Temperature indicator

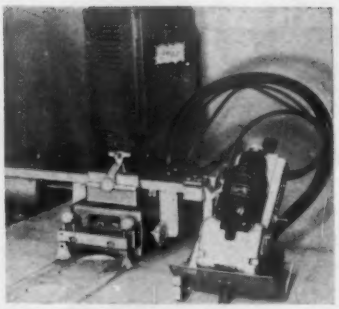
Spray-can package of temperature-indicating coating provides convenient method of coating large surfaces. Forty systematically spaced temperature ratings, covering the range from 100 F to 650 F inclusive are available. *Tempil Corp.*

Circle No. 56

D-c field welders

Two d-c diesel-engine-driven arc welding power plants are designed to withstand rough field usage. SDD-250 model has two welding ranges, a 150 to 350 amp high, and a 50 to 200 amp low. Unit has 250 amp d-c at 40 volts rated output and provides 115-volt d-c auxiliary power to operate portable hand tools while welding. SDD-250-L model is same but has 12 kw of 115/230 volt 60-cycle a-c power for auxiliary needs and up to 6.5 kw a-c power while welding. Generators and four-wheel trailers optional. *National Cylinder Gas Div.*

Circle No. 57



Automatic torch

Model Q-5 heavy-duty automatic torch is designed to automatically groove seams and prepare heavy plate edges for welding. Torch enables production of "U" groove plate preparation by butting square-edged plates together and producing groove in two plates in one operation. Unit consists of tractor-driven automatic head and contactor with remote control switch. Torch is designed to use electrodes ranging from ¼-in. to ⅝-in. maximum diameter, and operates on 80 to 100 psi air pressure. *Arcair Co.*

Circle No. 58

Grinding abrasive

Abrasive grain is designed for precision grinding operations like surfacing with abrasive segments. Field test reports show that abrasive segments grind more pieces per dressing with less tendency to burn and give longer life than previous segments. *Norton Co.*

Circle No. 59

Ductility testers

Self-contained adapter unit permits existing compression equipment to be used in making ductility tests on sheet metal up to 1/16-in. thick. Inexpensive unit offers results as accurate as those of machines costing three times as much, states *Detroit Testing Machine Co.*

Circle No. 60

Welding gun, torch

Welding gun for Mig and CO^2 welding (top) and automatic torch for Mig and Tig welding (bottom) have interchangeable barrels. Gun is fitted with adjustable piston grip. Torch can be mounted singly or in standard mount holding two torches for parallel or tandem welding. Units provide complete shielding using 25% less gas than any previous gun or torch, states manufacturer. Multi-barrel runs cool even at 600 amp. *National Cylinder Gas Div.*

Circle No. 61

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THE DURO "STANDARD"

* Featuring "Long Jaw Design" for reaching hard to get at places.
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* Insulated handle and guard protects the operator.
* All parts easily replaced.

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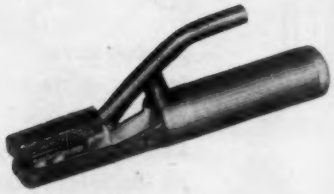

* Easy adjusting of Spring Tension for your requirements.
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* Aluminum model weighs only 13 oz.
* All parts replaceable including copper alloy jaw.

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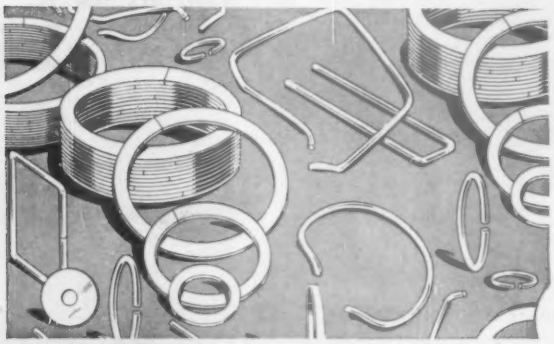

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716 Brazing Wire
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Automatic dust collectors

Automatic dust collectors are constructed of 3/16-in. polished aluminum. Units clean selves by periodic shaking of cloth filter tubes combined with reverse airflow through filters, continuous collected material removal by screw conveyor, and discharge of collected material through rotary feed valve. Eleven models from 4-ft 8-in. wide to 21-ft 10-in. wide are all 5-ft deep and 15-feet 6-in. high. Up to 58,000 cfm of air can be handled through a single 12 section model. *Torit Mfg. Co.*

Circle No. 29

Drum lifter

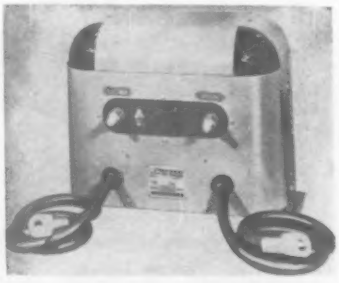
Non-tipping drum lifting attachment is designed for use with fork lift trucks. Unit will lift and carry any drum with its two drum clamps, any other object from its centered shackle. Unit automatically locks when forks slipped on yet disengages easily when load is released. Device will transform any fork lift truck into a mobile overhead lifting unit. *Merrill Bros. Inc.*

Circle No. 30

Water filter

Tell-Tale water filter is for use with resistance welding machinery. Limit switch increases life of electrodes by shutting off welder before filter becomes clogged and dirt enters water passages of electrodes. Model No. 20-S-74-E-5-40 is cadmium plated with stainless steel 74 micron (200 mesh) filter rated at 20 gpm. *Rosaen Co.*

Circle No. 31



Automatic arc starter

High-frequency automatic arc starter and stabilizer can be used with any a-c or d-c welder. Two models are designed to eliminate false starts even with low open-circuit voltage and stabilize arc on low-current settings for thin-gage a-c or d-c welding. HF 60 operates from 230-volt a-c source, and is rated 600 amp capacity. HF 60R has remote control. *Metal & Thermit Corp.*

Circle No. 32

For more facts Circle No. 199 on Reader Service Card

Spot welder

Model 369B welder can be used to weld small components and delicate parts of thin-gage material. Machine speed can be adjusted to operator's capability. Standard equipment includes conventional a-c control of C6H2 thyratron contractor, synchronous weld timer, and head control. With a-c welding control, a relatively long weld time at a low energy level can be used. Extremely high energy can be transmitted to the work piece in about one milli-second. Electrode force is obtained by means of a diaphragm within the 1 1/16-in. ID stainless steel cylinder. *Sciaky Bros., Inc.*

Circle No. 33

Flame cutter

Multiple-head flame cutter handles plate up to 20-ft wide in any length. Lightweight cutter has unlimited capacity for squaring large plate sizes, scarfing, beveling and edge preparation to close precision tolerances. Unit can be converted to a straight-line automatic welding rig. *Ty-Sa-Man Machine Co.*

Circle No. 34

Saber saw

Saber saw will make fast cuts through metal, plastics and pipe. Shoe keeps flush with work regardless of angle of cut or locks shoe as firm base to support tool in scroll cutting. Blade can be mounted to cut up, down or sideways. Saw is designed to make accurate pocket cuts in one uninterrupted operation. *Black & Decker Mfg. Co.*

Circle No. 35

Non-destructive tester

3000X Image Intensifier produces, by means of electronic x-ray image intensification, an image 3,000 times brighter than a conventional fluoroscopic screen. Brightness eliminates need for work in darkened rooms and lowers level of x-radiation required for inspection. System accommodates 16 and 35-mm movie and 35-mm still or Polaroid cameras. *Tracerlab Industrial Div.*

Circle No. 36

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Heavy duty, standard throat depth, (forged steel).
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Commercial duty, standard throat depth, malleable alloy.
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Series 500
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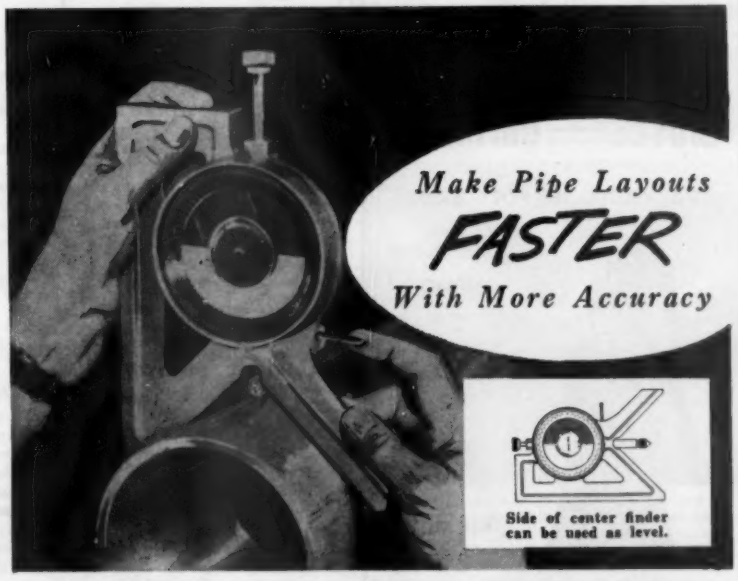

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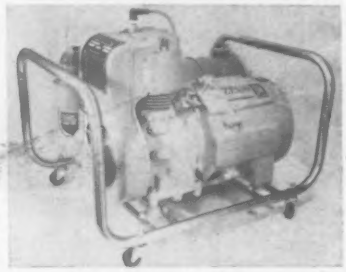
Circle No. 203 on Reader Service Card

Air regulator

Quick-adjusting air regulator has lever and coarse adjusting screw. A 180 deg lever turn adjusts regulator from 0 to 60 psi. A 360 deg turn adjusts it from 0 to 125 psi. Maximum primary pressure is 300 psi and maximum secondary pressure is 125 psi. Regulator has two gage ports or three outlets. Internal metal parts are brass with a buna-N soft seat. *Wilkerson Corp.*

Circle No. 37



Portable electric generator

Heavy-duty portable electric generator produces 3,000 watts of a-c power. Model GW-300 will provide packaged power on job site or in remote locations where electric power is needed. Permanent magnet alternator eliminates brushes, slip rings, or commutator. Magnet, internally fan-cooled and corrosion protected, connects directly to engine shaft with no coupling. Power supply for tools, motors, and auxiliary lighting is 115/230 volts, 60-cycle single-phase unit. Generator has two fuses for overload protection and three power outlets. *Borg-Warner Corp.*

Circle No. 38

Midget air cylinder

Maximum 200 psi air cylinder, small enough to hold in palm of hand, is available in ¾-in. and 1⅛-in. bore sizes. Standard strokes range to 12 in. in double-acting models with spring-return models also available. One-piece piston and stainless steel piston rod are permanently brazed together to prevent loosening during operation. O-ring seals assure dependable service at all working pressures. Special seals can be provided if working pressures exceed 165 F. *Hannifin Co.*

Circle No. 39

Coaxial ignitrons

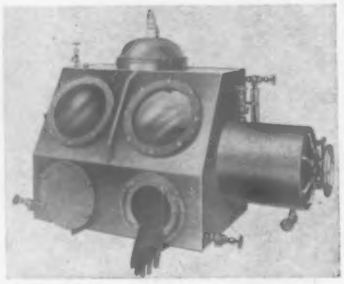
Coaxial welding ignitrons have both anode and cathode terminals at top of tube. This eliminates several inches of cathode terminal protruding from bottom of standard welding control tube. Coaxial terminal also eliminates bus bars required by standard ignitrons when used in inverse parallel. GL-7669 for size B welders and GL-7671 for size C welders are designed for use in standard 60-cycle applications. *General Electric Co.*

Circle No. 40

Work rubbers

Pack-A-Way flexible rubbers fit over safety shoes and give high degree of traction. Rubbers feature extra stretch for easier fitting, non-skid tread, translucent style and light weight. *U. S. Rubber Co.*

Circle No. 41



Laboratory enclosure

Laboratory enclosure facilitates chemical and metallurgical research on materials under high vacuum as well as work with radioisotopes and poisonous substances in controlled atmosphere. Standard units are 3-ft and 4-ft modules, but are available in any size. Vacuum dry boxes tested with mechanical pump have been pumped down to approximately 50 microns. Units have 12-in. diameter glass viewing ports on sloping front, a 12-in. diameter dome-type light, large autoclave-type door handles, a 15-in. diameter airlock and a rear access panel 12 in. by 18 in. Units are made of ¼-in. stainless steel plate. *S. Blickman, Inc.*

Circle No. 42

Fire detection system

Fire detection system uses principle of heated air expansion. Air at atmospheric pressure is contained in circuit of copper tubing running on ceilings throughout protected area. Ends of circuit terminate at detector. Abnormal continued rise in temperature, such as fire would cause, expands air, rapidly sounding the alarm and operating necessary mechanical devices. System features fast operation in any temperature range, local or remote alarm, no replacement parts, pinpointing of fire locations and concealable and paintable tubing. *Kidde Ultrasonic & Detection Alarms, Inc.*

Circle No. 43

Dial-indexing welder

Dial-indexing welder manually loads two small transistor case halves, does ring projection welding and ejects automatically. Welding head is low-inertia anti-friction linear-ball-bearing diaphragm type with selective deflection firing. Indexing table is eight-station Geneva motion motor-driven with electric clutch brake. *Acro Welder Mfg. Co.*

Circle No. 44

Power hammer

Electric power hammer delivers about 2,500 blows pm for chipping scale, rust or weld spatter. Piston rod is designed with nylon buffer; connecting rod is forged aluminum and crosshead stem is chrome-plated. Hammer weighs 11¾ lb without cable and 12¾ lb with cable. Hammer's motor operates on standard 115-volt a-c/d-c current with motor rating of 5.0 amp. A 230-volt motor with 2.5 amp rating can be furnished. Hammer accommodates drills up to 1⅛-in. diameter hole size. *Ingersoll-Rand Co.*

Circle No. 45

Power supply

Medium range electronic welding power supply with range selector switch for finer control at low settings has automatic lockout to prevent premature discharging. The VTW-32, has range selector switch allowing either 1 to 25 watt-second or 10 to 250 watt-second range. Range switch automatically discharges stored energy, changes meter calibration and allows power supply to charge to new setting. Unit allows 7,200 welds an hour with exact repeatability of weld energy released in 0.002 of a second. *Hughes Aircraft Co.*

Circle No. 46

Heating wire

"Thermocoax" high temperature heating wire can be used in heating objects in a vacuum or under pressure. Highly flexible wire is simply coiled around object and brought out through the oven. Using sealed bushings, the points where the wires are introduced into the heating system can be hermetically sealed. Wire is available in diameters ranging from 1 mm to 2 mm and in lengths up to 280 ft. It may be heated to temperatures as high as 2,012 F, with maximum permissible current reaching 32 amp. *Amperex Electronic Corp.*

Circle No. 47

High-pressure regulator

No. XX-87 high-pressure regulator delivers up to 2,500 lb psi and is provided with 4,000/4,000-lb gages. Regulator was developed for use in oil refineries, chemical research laboratories, and general industry for hydrogenation, catalytic reduction, calerimetry, accelerated age-testing and pressure testing. *Harris Calorific Co.*

Circle No. 48

Safety control

Air compressor safety control interlocks with compressor motor starter and when used with sensing elements installed in the compressor air, water, and oil systems will stop motor if overheating occurs or when oil pressure, water pressure or oil level drop below safe limits. Model A-15 prevents overcooling and undercooling. Unit, which can be used in resistance welding operations, automatically regulates water flow to compressor. Terminals are provided on control to which alarm supplied from separate power source can be connected. Alarm will sound when compressor stops. *Van Vooren Products.*

Circle No. 49

For more facts Circle No. 204 on Reader Service Card

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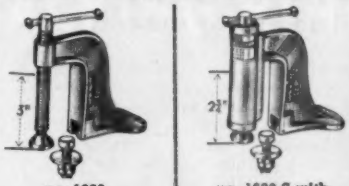

no. 1623 without shield

no. 1623-S with shielded screw

NOW with shielded screw for welding service.

Can be spotted on any work-surface (wood or metal), drill press or "T"-slot table. Ideal for temporary or permanent production set-ups.

Clamp slips "on" and "off" pre-spotted holding-bolt in seconds. It's there when needed, out of the way when not in use. Functions equally well in the middle or near the edge of work area. Doubles as vise along side of bench.

Patented "Jorgensen" steel shield POSITIVELY protects screw against welding "spatter" or other damage.

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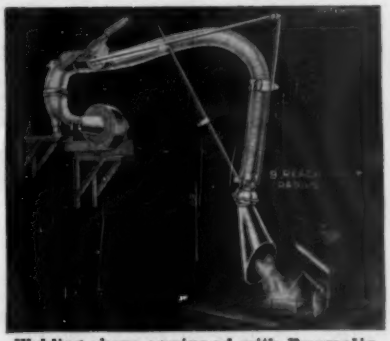

Welding shops equipped with Ruemelin Fume Collectors are assured of a clean shop atmosphere. Noxious fumes, heat and smoke are eliminated AT THEIR SOURCE. Improves working conditions . . . lessens fatigue . . . paves the way for increased plant production. Especially helpful in winter months when windows and doors are closed.

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WAS BORN

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TIME PROVEN - MODESTLY PRICED
WHY EXPERIMENT?

Regalvanizes corrosive seams and areas where galvanizing is burned away by welding, skipped in hot dip galvanizing, or abraded in fabrication.

Eliminates corrosion areas produced by welding, so that weld will stand up under paint, WITHOUT rust, as on ornamental iron. Simply use residual heat from welding, or reheat, wire brush, and apply. No fluxing—No fumes.

Makes every welder a galvanizer of small weldments or parts. Repairs chipped porcelain, rusted appliances, rusted auto, truck or trailer bodies, frames, fenders, or other steel products. Can be readily refinished to match surrounding surface.

Ideal for pipe joints, galvanized structures, water and fuel tanks, duct systems, cold storage lockers, sinks, drains, washers, towers, steel buildings, railings, etc.

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Circle No. 209 on Reader Service Card

Battery chargers

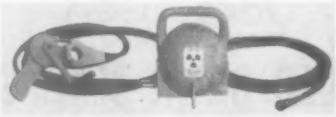
Two battery chargers are designed to operate from electric welders. Both models charge 500 amp at 6 volts or 30 amp at 8 or 12 volts. Model 140-4 will also charge 24 volts at 30 amp. Both have 10-ft battery cable with insulated clamp. A self-contained 110-volt charger is also available. This unit will operate on 6, 8 or 12 volts and can deliver 50 amp on 6 volts, or 30 amp on 8 or 12 volts for quick charges. *Twentieth Century Mfg. Co.*

Circle No. 50

High-vacuum oven

Cold-wall high-vacuum bake oven can operate continuously at any temperature within ranges of 0-500 C and 0-800 C. Temperature uniformity in work zone is held to within ±3 C. Suspended muffle is heated by radiant heaters and reflective shielding. Ovens, with single or double end doors, are available in two sizes: 8 in. by 8 in. by 14 in. and 14 in. by 14 in. by 16 in. *Tri Metal Works, Inc.*

Circle No. 51



Radiography cameras

Iridium 192 cameras for industrial radiography have capacities of 10, 25, 35, 50 and 100 curies of iridium 192 respectively with weights ranging from 50 to 100 lb. Iridium 192 is useful in radiographing from ¾ in. to over 3 in. of steel or from ¾ in. to over 9 in. of aluminum. Hand truck mounts are available at small extra cost. *Radionics Inc.*

Circle No. 52

Industrial regulator

Industrial regulator with interchangeable component stock parts has more than 96,000 different industrial applications, says manufacturer. With inlet pressures up to 3,000 psig and outlet pressures up to 500 psig, the unit regulates compressed air and all non-corrosive commercial gases. *Modern Engineering Co.*

Circle No. 53

Wet-grip glove

Neoprene-coated canton flannel-lined gloves feature wet-grip for handling oily sheet metal stock with sharp edges. Gloves provide resistance, dry grip, abrasion resistance, snap resistance and puncture resistance. Available in six styles, with special styles on request. *The Granet Corp.*

Circle No. 54

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The Bateman "Bantam" cuts 2" x 2" x ¼" angles and ¼" x 4" flats. Standard punches will fit this machine. The Coper will cope 1¼" through ⅛" material. It will punch ½" hole through ¼" material. With the clutch open, the Bantam will make 44 strokes per minute. It is made of high-grade cast iron, with the clutch, pin and dog made of hardened steel. The blades are made with tool steel. It is powered with a fly wheel and gear drive, and uses a small ¾ hp motor, 1750 rpm.

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Shear only $495.00
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MINERAL WELLS, TEXAS

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Free Literature

. . . use card on p. 103

75. WELDING STAINLESS STEELS — The McKay Co. Manual is general reference guide on entire subject of stainless steel welding with detailed explanations on stainless steels in common use.

76. SQUIRT WELDER — The Lincoln Electric Co. Bulletin No. 5205.2 describes operating features, construction details, and application information on a new trackless carriage for firm's semi-automatic Squirt welder.

77. IRON POWDER — Alan Wood Steel Co. Technical data bulletin reports results of extensive tests on grades of firm's iron powder in performance graphs and tabular listings.

78. WROUGHT IRON REDUCERS — Steel Forgings, Inc. Illustrated sheet with prices and sizes (1 in. through 24 in.) of firm's wrought iron reducers.

79. WELDING FITTINGS — Babcock & Wilcox Co. eight-page booklet, FB-502A, covers seamless welding fittings and flanges in carbon, alloy and stainless steels.

80. HAND TRUCKS — Harper Trucks, Inc. Form No. HTI-1 is four-page, three-color, guide with full specifications, including load capacity, height, width, weight and wheel diameter, of firm's industrial hand trucks.

81. FACE SHIELDS — Flood Safety Products Co. Bulletin No. 20, a two-page sheet, fully illustrates and describes all features of firm's face shields and gives sizes.

82. WELDED STEEL TUBING — Armco Steel Corp. Illustrated four-page folder P. O. 6759 describes welded steel tubing available as fabricated or semi-fabricated items in five different steels.

83. REGULATORS AND LUBRICATORS — Hannifin Co. Illustrated Bulletin 0400-B1 provides complete catalog listing and engineering and application data on filters, regulators and lubricators.

84. WATER STORAGE TANKS — Chicago Bridge & Iron Co. 20-page brochure describes design and function of elevated steel tanks for water storage with photographs of structures now in service.

85. HINGED CLOSURES — Tube Turns Div. of Chemetron Corp. Revised bulletin (TT956) describes new design features and extended size ranges for firm's line of one-man hinged closures.

86. ELECTRODE SELECTOR — Ampco Metal, Inc. Pocket slide chart provides finger-tip accessibility of pertinent resistance welding data.

88. HYDRAULIC EQUIPMENT — Groban Supply Co. 64-page catalog and hydraulic reference manual covers electrical, hydraulic and mechanical items used for original manufacture or maintenance.

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★ ASSEMBLED OR TAKEN APART IN MINUTES WITHOUT TOOLS

Just think of it—no hooks, no bolts, no screws. Ideal for welding, grinding, machining etc. or can be used straight line as a protecting divider. Rust-proof steel frame with heavy fire-resistant duck curtain—attaches in seconds with with heavy duty snap fasteners.

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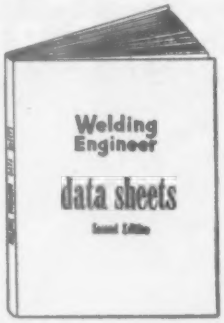

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90. PLASTIC WELDING — Kamlar Products Co. Manual 60-2 gives operating and maintenance instructions for firm's plastic welding equipment.

91. WELDING AWARD PROGRAM — James F. Lincoln Arc Welding Foundation booklet contains details of foundation's new $25,000 award program for progress in welded design.

92. SPOT WELDER — Peer, Inc. three-color form (No. 300-760) lists and illustrates features of firm's Uni-Strut spot welder.

93. PROJECTION WELDING — Taylor Winfield Corp. 20-page brochure (Bulletin SP-27) gives detailed information on projection welding of low carbon steel with embossed projections.

94. FLAME-PLATED COATINGS — Linde Co. Bulletin F-1246-A lists the compositions and physical constants for flame-plated coating metal parts.

95. WEIGHT COMPUTATIONS — Jones & Laughlin Steel Corp. 16-page color brochure gives information and tables on weight computations for welded steel tubing.

96. TELESCOPING CYLINDERS — Ampco Metal, Inc., Welding News No. 84 has article on telescoping cylinders with welded parts. Illustrated four-page paper has other articles on firm's products.

97. X-RAY UNIT — General Electric Co. Product Data Sheet A4611 gives specifications, applications and features of firm's Resotron 300 x-ray inspection unit.

98. EYE, FACE PROTECTION — Mine Safety Appliances Co. 40-page catalog (No. 0300-1) lists and illustrates firm's eye and face protection line including vision testing equipment, goggles, faceshields, welding helmets, accessories and parts.

99. METAL CORROSION — The H. M. Harper Co. 4-in. by 8-in. card works like slide rule to tell how eight metals withstand corrosive effects of 141 chemical agents.

100. WELDING, CUTTING — National Cylinder Gas Div. 16-page booklet (NTW-110) describes and illustrates firm's welding torches, cutting attachments, tips, economizers, regulators and assemblies.

101. WELDING HELMETS — Flood Safety Products Co. four-page folder, Bulletin No. 21, shows firm's complete fiberglass and vulcanized fiber helmet line.

103. MASH SEAM WELDING — National Electric Welding Machines Co. illustrated six-page Welding News, Vol. 12, No. 1, describes advantages of mash seam welding as a high speed, high strength, low buildup method of coil joining.

104. EYE, FACE SAFETY — Sellstrom Mfg. Co. 16-page illustrated catalog (No. S-37) includes plastic frame and metal frame safety glasses, cover and clip-on goggles, plant visitor glasses, fiberglass face shields and sweat bands.

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107. FIBER INSULATION — Johns-Manville Corp. Product Information Sheet IN-283-A describes firm's lightweight refractory fiber insulation and lists forms, uses and advantages.

108. HARDFACING — Wall Colmonoy Corp. four-page two-color data sheet (No. 55) discusses typical manganese steel uses and the need for hardfacing.

109. T-1 STEEL WELDING — Alloy Steel and Metals Co. Bulletin No. 300 gives welding and machining data for T-1 alloy steel.

110. SEAM WELDER — Sciaky Bros. Inc. Bulletin 320-8, two colors and eight pages, describes and illustrates firm's air-operated press-type three-phase seam welder.

111. INDUCTION HEATING — Induction Heating Corp. 52-page illustrated revised catalog-handbook pictures latest developments in Ther-Monic induction heating equipment.

112. BARREL FINISHING — Syntron Co. four-page brochure includes specifications, data and illustrations of firm's newer models for grinding, descaling, polishing, deburring, burnishing or drying unfinished parts.

113. WELDING NECK FLANGES — Harrisburg Steel Co. 24-page catalog includes specifications for welding neck flanges and drop-forged steel flanges. Complete charts are included.

114. STAINLESS STEEL WELDING — The McKay Co. six-page folder contains a chart on the chemical and physical specifications of firm's stainless steel electrodes.

115. HIGH-TEMPERATURE ALLOYS — Haynes Stellite Co. 20-page form (F 30,134) gives selected comparative properties of firm's wrought and cast high-temperature alloys.

116. SILVER ALLOY BRAZING — Handy & Harman Brazing News No. 84, two-colors four pages, lists successes of firm's silver alloy brazing in 12 problems.

117. DEGREE LEVEL — Manning Mfg. Co. two-color catalog sheet illustrates firm's precision degree level.

118. HIGH TEMPERATURE STEELS — Babcock & Wilcox Co. six-page folder (T-467) contains information on 15 steels widely used in high-temperature service.

119. ELECTRONIC TUBES — Amperex Electronic Corp. 25-page tube catalog contains descriptions and basic specifications on full line of tubes.

120. RAM BENDERS — Wallace Supplies Mfg. Co. four-page folder illustrates firm's line of pipe benders.

134. WELDED STORAGE TANKS—Chicago Bridge & Iron Co. Brochure illustrates several special elevated water storage tanks built as king-size replicas of consumer products.

135. TEMPERATURE STICKS—Princeton Div., Curtiss-Wright Corp. Full-color folder depicts and discusses the uses and types of temperature-indicating crayons and paints.

136. PREHEAT METHOD—J. B. Nottingham & Co., Inc. Practical method of preheat that permits quality welds on low-alloy high-tensile steels is outlined in illustrated bulletin.

131. OXYACETYLENE CUTTING — Smith Welding Equipment Corp. dial-a-tip card (Form No. DAT-A) lists firm's tip number for various oxyacetylene cutting purposes on rotating pocket dial.

138. DIAMOND WHEEL—Manhattan Rubber Div., Raybestos-Manhattan, Inc. Comprehensive catalog describes complete line of diamond wheels, with complete set of net prices enclosed.

139. FITTING KITS—Parker-Hannifin Corp. Catalog sheet 4482 A-22 illustrates and provides specifications for general purpose hose fittings.

140. CENTRIFUGAL COMPRESSOR—Allis-Chalmers Mfg. Co. Design and construction features of multi-stage centrifugal compressors are described in new bulletin, which includes a keyed cross-section view of a horizontal split unit, and tables on performance curves.

141. WELDING PLATENS — Acorn Iron and Supply Co. two-color illustrated sheet shows firm's welding platens and explains their use.

142. BOOSTER UNITS—S-P Mfg. Corp. Simplified handbook describes firm's complete line of air-hydraulic interchangeable boosters, gives data on single- and double-pressure systems, proper tank selection, etc.

143. GRINDING WHEELS—Norton Co. Booklet on grinding wheels for the welding trade contains photographs and tables as well as net price supplement.

144. PORTABLE NIBBLERS—Fenway Machine Co. Complete line of portable nibblers fully described in 2-color brochure.

145. TITANIUM WELDING—Nooter Corp. Booklet discusses methods of welding titanium by the shielded arc, spot, seam and flash methods, includes charts cataloging various types of titanium and titanium alloys.

146. WELD SCREWS — Parker-Kalon Div. 20-page weld screw manual gives applications of firm's weld screws with welding hints and terms.

147. DIAL FEED WELDER — Raytheon Co. Product Data 2-271 in two colors gives description, lists features, and illustrates firm's continuous-dial feed welder.

148. ABRASIVE CUTTING MACHINE — Allison-Campbell Div. two-color four-page folder (DH-260-R) illustrates and gives specifications of firm's 406 Cutamatic abrasive cutting machine.

149. SAFETY GLASSES—Pulmosan Safety Equipment Corp. Flysheet describes, illustrates and gives specifications on safety glasses.

150. ELECTRIC HEATERS—General Electric Co. 48-page catalog lists industrial electric heaters and devices with application data.

WELDING

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USE THIS CARD for literature, catalogs, and bulletins shown on preceding pages and on the following page, and for more information on advertisements in this issue

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Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

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★ For additional information on New Products described in this issue, circle the numbers of the items that interest you. The New Products section begins on page 87.

WARNING!

Illegible or incomplete addresses may keep you from receiving the information you desire. And remember, cards postmarked after the deadline date cannot be processed.

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Company _____

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Welding Engineer
P.O. Box 28
Morton Grove, Ill.

Advertisers' Literature

Literature offered in advertisements which were received up to the 5th of last month. To get the literature you want circle numbers on Reader Service Card on this page.

196. All-State Welding Alloys Co., Inc. — For information on custom coating your welding rods write for the 54 page instruction manual.

167. Ampco Metal, Inc. — Bulletin RW-10 further explains welding dies of all types made by Ampco.

154. Bernard Welding Equipment Co. — Bulletin 102 available on Bernard cable connectors.

183. Branson Instruments, Inc. — Bulletin T-208 and T-200 available on "Sonoray" flaw detection for precision ultrasonic measurements.

174. Bridgeport Brass Co.—"Bronze Welding" is a booklet on Bridgeport welding rods.

208. Coast Metals, Inc.—Loose leaf binder contains latest information and technical data on the coast metals line of arc and gas welding rods, automatic wire and castings for critical parts.

191. Electric Arc, Inc. — Write for brochure, "Smith-Dolan System of Low-Frequency Induction Heating.

193. Emerson Electric of St. Louis. — Welding selector guide available and prices on the new Emerson Tig welder.

176. Eutectic Welding Alloys Corp. — Literature on "EutecSil 1020 FC," flux-coated rods for silver brazing, is available.

153. Falstrom Co. — Catalog WC-60 available, contains information on the "Controlled angle torch" also name of your nearest distributor.

190. Fibre-Metal Products Co. — Bulletin No. 65 available on "SuperGrip" electrode holders.

209. Galv-Weld Products — Write for information and sample of galvanizing manufactured by Galv-Weld.

178. Glenn Pacific Power Supply Corp. — Literature and specifications on the new "Glenn Variable Slope" constant voltage power supplies is available.

177. Handy & Harman — For a complete picture of silver brazing and its advantages write for Bulletin 20.

151. Hobart Brothers Co. — Bulletin U-11 on Hobart's line of arc welding equipment is available.

150. Jackson Products — Catalog available on Jackson's "Sealed Tight" holders.

161. Liquid Carbonic Div. — "Welding and Cutting Apparatus Catalog No. 5900" gives complete information on torches and regulators manufactured by Liquid Carbonic.

198. Lucas-Milhaupt Engineering Co. — Booklet available on aluminum brazing.

163. Merrill Brothers — Catalog C-2 available describing Merrill drum lifters and other material handling devices.

165. Metal & Thermit Corp. — Copies of the "Murex" electrode selector is available, giving over 1000 types and sizes of electrodes manufactured by Metal & Thermit.

169. Miller Electric Mfg. Co., Inc. — A booklet illustrating and describing all Miller welders "A Full Line of Fine Welders" is available.

195. No-Arc Equipment Co. — Bulletin available on the No-Arc electric welding gun.

156. Page Steel and Wire Div. — Folders DH-402 and DH-1218 contains information on submerged arc and inert gas automatic welding wire.

153. Rankin Mfg. Co. — Bulletin No. R 101 on the new "Ranomatic" wire for automatic and semi-automatic hardfacing, is available.

157. Ransome Co. — "Guide to Positioning Equipment" booklet is available.

180. Riegel Textile Corp.—A Glove Guide to help you select the glove that gives the greatest protection is available.

216. Singer Glove Mfg. Co. — Catalog available on Singer Screens, welding gloves and safety clothing.

160. Tuffaloy, Air Reduction Sales Co. — Catalog available describing the new RW Taper numbering system for spot welding electrodes.

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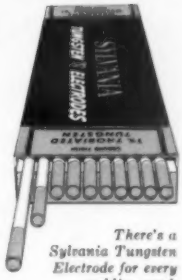

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A hot-water storage tank starts by rolling a plate of Everdur-1010 (29¾" x 170" x .282") to form one of four cylindrical sections. The fabricator, Old Dominion Iron and Steel Corporation of Belle Isle, Richmond, Virginia, finds Everdur-1010 easy to roll cold

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